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BONE DISEASES IN INFANCY AND CHILDHOOD*

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THE object of this paper is to discuss briefly the important bone and joint diseases occurring in infancy and during childhood. These conditions include rickets, scurvy, syphilis, tuberculosis, non-specific epiphysitis, osteochondritis, osteomyelitis, osteogenesis imperfecta, achondroplasia, Still's disease, marble bones, cretinism, multiple cartilaginous exostoses, multiple myeloma, coxa vara, hemophilia, coccidioidal granuloma, tumors, enchrondroma, typhoid and typhus fever, infectious periostitis, aseptic necrosis and infantile osteomalacia.

These subjects are discussed under the following headings: history, age, changes in the various structures such as the epiphysis, the epiphyseal line, the diaphyseal line, the shaft, medulla, cortex, periosteum, and the joint: atrophy, fractures, deformities, special remarks, treatment and prognosis.

RICKETS

Rickets is one of the most common diseases affecting the bones and joints of infants. The bone changes are part of a generalized nutritional disturbance. The disease is usually seen between the sixth and twenty-fourth months. Most authorities agree that the so-called "fetal rickets" does not exist and it is a very misleading term.

The roentgenographic findings are quite characteristic. The disease is prone to attack the ends of the bones, most of the changes occurring near the epiphyseal line. The shafts of the bones are soft and curved due to the lack of calcium. We have comparatively few fractures of rachitic bones. The small number of fractures seen in our clinic may be due to the fact that diagnosis is made early and appropriate treatment instituted immediately. These patients are very often seen before they have walked, consequently very little weight is borne upon the extremities.

The epiphyseal and diaphyseal lines are the parts of the bone that show the characteristic changes. The epiphyseal line is irregular and hazy. The diaphyseal line is irregular and shows the characteristic saucer shaped deformity. The epiphysis is softened, often mushroomed and usually enlarged. The joint surfaces are irregular and poorly developed. The periosteum is normal as a rule. There is usually thickening of the cortex on the concave side; this may be exaggerated by the atrophy that often accompanies the disease. The skulls of rachitic patients present the characteristic square forehead. The rachitic rosary so often described has not been a common finding in the roentgenograms of our cases. In some of the more severe cases there may

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be a definite rosary with large nodes at the sternal end of the ribs which may cause an atelectatic band across the lungs, due to pressure. At autopsy the inner surface of the thorax reveals more marked rosary formation than the external surface.

Adolescent Rickets. There is considerable discussion of the question as to whether adolescent rickets is a definite entity, that is, a condition *de novo*, or a recrudescence of an infantile condition that has remained dormant during a period of comparative osteogenetic inactivity. It is the writers' belief that it does occur in patients who have no evidence of rickets, for example, at the age of ten years, and who develop deformities between the tenth and fourteenth years. This subject together with its relationship to renal dwarfism is discussed more fully in another article[1] by one of the writers.

FIG. 1. Rachitic coxa vara with unsuccessful osteotomy.

SCURVY

Scurvy is a disease of early life occurring between the sixth and the eighteenth months. It is definitely a nutritional disturbance. The disease was recognized as early as 1772, when Linds described it.

Scurvy is a very rare disease in our experience probably due to the improved prophylactic methods of feeding children. The majority of very young infants are now given fruit juices of various kinds, even in the humblest of families.

The characteristic changes occur just behind the diaphyseal line. In this region the typical Trömmer's line is found. This line is an area of decalcification presenting the appearance of a second epiphyseal line. The periosteum is elevated due to hemorrhage which causes a stripping of that structure. This hematoma may undergo calcification. The degree of deformity depends upon the amount of hemorrhage. The epiphysis and the epiphyseal line are normal. The joint surfaces and the joint spaces are normal. The shaft may show definite thickening on the convex side. There is no change in the medulla except in the region of Trömmer's zone. In the severe types there is a great deal of atrophy of disuse due to the great pain, which is exaggerated on even the slightest movement. A severe grade of scurvy is one of the

[1] Lewin, Philip. Adolescent rickets. *Surg., Gynec. & Obst.*, 1922, xxxv, 77–83.

most painful conditions an infant may have. There is usually an accompanying hemorrhagic gingivitis and if teeth are present, they are the seat of nutritional disturbances. The writers have never seen a pathological fracture in scurvy.

LUES

Lues in infancy and childhood is congenital or hereditary. The disease usually manifests itself before the seventh year. Not all bones are affected to the same extent, some may be normal. The disease is most frequently found in the lower ends of the femora, the ends of the tibiae, the distal ends of the ulnae, radii and metacarpals, in the order named. No bones are exempt; even the vertebrae, ribs and the skull may be affected.

FIG. 2. Two-stage growth of epiphyses, giving the appearance of an epiphysis within an epiphysis (courtesy of Dr. Julius Hess).

The shadows are due to changes in the calcification of the proximal cartilages and to abnormal arrangement of the osseous tissues. In the fetus the changes are confined to the epiphyseal-diaphyseal junction except in the severe cases. The periosteal changes are secondary to the endochondral defect. The periosteal changes do not take place until after birth. There is a definite sclerosis of bone at the epiphyseal line. The bone seems to have a very thick cap. This is due to increased calcification. The provisional calcified zone is much wider in lues than in the normal, measuring 0.5 to 1.5 mm. The thick band may be confused with the band found following the treatment of rickets. There is often a clear zone separating the cortex from the spongiosa. There is no interference with the growth of the bone.

FIG. 3. Healed fractures in osteogenesis imperfecta

Lues does not affect the epiphysis or the epiphyseal line. The articular surfaces are normal. The characteristic findings are located at the diaphyseal line where irregular gouged out areas can be seen. The shafts of the bones show changes such as thickening of the cortex seen in saber shin. The thickening of the cortex is more evident on the convex side in contrast with rickets. The periosteum is usually thickened. Deformities are very common and

may be of extreme grade. Fractures are uncommon in the experience of the writers.

There is usually a great deal of swelling of the periarticular tissues accompanied by fluid in the joint. The lesions in lues are usually multiple but may be confined to small areas.

TUBERCULOSIS

In the diagnosis of tuberculosis the history is very important. There is usually a history of injury and the physical examination will often reveal other tuberculous foci. It occurs usually between the ages of three and ten years, and the physical findings of importance are: limitation of motion, muscle spasm, limp when weight-bearing joints are affected, local and referred pain, night cries, swelling due to exudate with obliteration of joint landmarks, atrophy of bone and muscle, deformity, tenderness and sensitiveness, increased joint tension and increased local temperature. General symptoms of importance are weakness, malaise, anorexia, etc.

The various tuberculin tests are of importance in the very young. The roentgenographic findings are haziness or clouding of the joint space, narrowing of the joint space, bone atrophy and bone destruction. Under three conditions, viz., secondary infection, calcification of an exudate and periosteal involvement one might observe bone production. Aspiration, biopsy and guinea pig inoculation tests may be necessary in order to make the diagnosis. Allison states that tuberculosis, syphilis and gonococcus infections may be indistinguishable roentgenologically and oftentimes it is impossible to differentiate tuberculosis from syphilis in microscopic sections of tissue.

FIG. 4. Hereditary deforming chondrodysplasia, diaphyseal aclasis or multiple exostoses.

FIG. 5. Coccidioidal granuloma of first metacarpal.

Phemister's work on the differences in destruction of cartilage in tuberculous and pyogenic arthritis is very important and should be reviewed briefly here. In pyogenic arthritis the cartilage disappears first at the points of contact and greatest pressure of opposing surfaces. In tuberculous arthritis the cartilage is destroyed first in the region where it is not in contact with opposing articular surfaces.

NON-TUBERCULOUS EPIPHYSITIS

Epiphysitis occurs, as a rule, between the ages of three and fifteen years. The disease often follows injury, infection, glandular involvement, or a combination of these factors. Pain, limitation of motion, spasm, etc., are less marked than in tuberculosis. The epiphysis is the part of the bone affected, although the process may extend into the joint. At first there is swelling and edema of the soft tissues, but no abscess formation, as a rule. In contrast to tuberculosis the outlines of the bones are usually sharply defined and a good film can be obtained. The epiphysis becomes rarefied and reveals multiple small areas of bone destruction often widely separated. The infection is usually confined to one joint although it may be multiple. In the case of the upper end of the femur, if weight bearing continues the head of the femur will become deformed or if the infection is severe it will be destroyed. Unlike a tuberculous process there is often considerable bone production followed by bony ankylosis. This fact affords a point of diagnostic value in differentiating acute non-tuberculous epiphysitis of the hip from Legg-Calvé-Perthes' disease, in which latter condition ankylosis does not occur. It is quite common to see the infection spread through the articular surfaces and involve the acetabulum in epiphysitis, while in Legg's disease this does not occur.

In epiphysitis the diaphyseal line may show areas of destruction in the earlier stages of the disease and as the disease subsides the line may become calcified. The shaft, cortex and medulla are, as a rule, not involved. Fractures are very uncommon in these cases but an epiphyseal separation or epiphyseal slipping is frequently observed. There is a type seen in cases of Froelich's syndrome (dystrophia adiposogenitalis). The child is considerably overweight and sex characteristics are delayed or abnormal.

OSTEOCHONDRITIS DEFORMANS COXAE JUVENILIS—LEGG'S DISEASE

Legg-Calvé-Perthes' disease usually occurs between the ages of four and ten years with the typical history of a minor injury following which the child develops a slight limp with some limitation in abduction and external rotation. These cases were formerly thought to be due to tuberculosis but the idea was abandoned as they usually improve too rapidly to be tuberculous. At present the cause of the disease is not agreed upon, many different opinions have been offered but none universally accepted. There are some who believe lues is the cause, while others attribute the changes to a trophic disturbance. Freiberg believes the disease is due to an

Fig. 6. Coccidioidal granuloma of patella.

infection and traces some of his cases to and following tonsillitis. One of the writers has personally talked with Legg, Calvé, Perthes, Jansen and Calot, all of whom have written extensively on this subject and they all disagree on etiology and treatment. The disease attacks the head and the neck of the femur primarily. It may be bilateral but is usually unilateral.

The disease begins in the head of the femur. The outlines of the bones and joint are quite sharply defined in contrast to a tuberculous lesion. The head of the femur becomes soft and there is a widening of the neck with proportionate narrowing of the shaft. As the disease progresses the

DIFFERENTIAL DIAGNOSTIC CHART

	Rickets	Scurvy	Syphilis	Tuberculosis	Epiphysitis
History	Malnutrition.	Malnutrition.	Congenital.	Injury. Other foci.	History. Infection. Glandular disturbance.
Age	6–18 months.	6–18 months.	Infancy to 7 years.	3 to years.	3–15 years.
Epiphysis	Softened, mushroomed, enlarged.	Normal.	May be normal.	Affected, may be destroyed.	Affected variously.
Epiphyseal line	Irregular, hazy.	Normal.	May be normal.	Affected.	Irregular. May be destroyed later.
Diaphyseal line	Irregular, saucer shape.	Trommer's zone behind diaphyseal line looks like a second epiphyseal line.	Gouged out areas on diaphyseal side of epiphyseal line.	Affected.	May show areas of destruction. Later sclerosis.
Shaft	Curved.	Normal except for subperiosteal hemorrhage.	Dactylitis. Saber tibia in older children due to osteitis.	Usually normal.	Normal.
Medulla	Normal.	Normal except at Trommer's zone.	Normal.	Usually normal.	Normal.
Cortex	Thickened on concave side.	Normal.	Thickened on convex side.	Normal.	Normal.
Periosteum	Normal.	Subperiosteal hemorrhage and stripping of periosteum.	Excessive proliferation.	Rarely involved.	Normal.
Joint	Surface may be irregular and poorly developed.	Normal.	Intact.	Hazy. Cloudy. Narrowed.	Changes depend upon degree of destruction and repair.
Atrophy	Slight.	Of disuse + +.	None.	Of disuse + neurotrophic.	+ or −.
Fractures	Do occur but infrequently.	Rare.	Uncommon.	None.	Epiphyseal separation common.
Deformities	Very common, may be extreme.	Absent except from hemorrhage.	+ + possibly due to concurrent malnutrition.	Due to bone destruction, gravity. Contraction + contractures of soft parts.	Of the epiphysis.
Special remarks	Square forehead, rosary, pot-belly, deformed chest. Altered blood chemistry, especially calcium and phosphorus balance.	Intense pain on jarring. Hypersensitive to movement.	Periarticular swelling with fluid. Lesions usually small area, but multiple.	X-ray may be inconclusive.	Bony outlines usually clear.
Special remarks		Hemorrhagic gingivitis.	Lack of pain and spasm proportionate to involvement Wassermann child and parents.	Syphilis, Tbc and G. C. may produce similar findings.	There may be a history of 2 injuries.
Treatment	Dietetic, medicinal, heliotherapy and its substitutes, orthopedic.	Dietetic. Orange juice, other fruits and vegetables.	Disproportion between clinical and X-ray findings. Other evidence of syphilis.	Orthopedic, hygienic, heliotherapy.	Orthopedic, immobilization, general or glandular.
			Hg, KI, As.		
Prognosis	Very good.	Excellent.	Good?	Guarded. Cure with motion is very rare.	Good.

rarefaction increases. If the patient is not put at rest and weight-bearing is permitted, the head becomes flat and deformed. The degree of limitation of motion and permanent deformity in later years depends upon the amount of mechanical deformity. It is not uncommon to find the bones of the pelvis on the affected side atrophied. Atrophy of the soft tissues is present but less marked than in tuberculosis.

The disease is practically self limited. There is usually one year of the softening which is then followed by hardening and rebuilding. If during the stage of softening leg extension is used, much of the deformity can be prevented.

The roentgenographic findings during the first year show very soft bone while during the second and third years the bone becomes more dense and repair takes place.

DIFFERENTIAL DIAGNOSTIC CHART

	Osteochondritis	Osteomyelitis	Osteogenesis imperfecta	Achondroplasia	Still's disease	Marble bones
History	Injury, males + +	Injury or infection, males + +	Congenital.	Congenital.	Infection, exposure.	Pathological fracture may be first sign.
Age	3–15 years.	2–10 years.	———	———	Any age.	Youth.
Epiphysis	Flattened, broadened, destroyed or fragmented.	Usually resistant.	Normal, centers normal.	Affected like rickets.	Affected. Atrophy + + .	Increased density with absence of bony structure.
Epiphyseal line	Irregular.	Is a natural barrier.	Widened.	Affected like rickets.	Atrophic.	Slightly irregular margins.
Diaphyseal line	Broadened.	Usual point of origin if hematogenous.	Normal.	Affected like rickets.	Atrophic.	Increased density.
Shaft	Normal.	Affected in traumatic type. Tibia + + .	Affected. Fractures.	Short and wide.	Normal except for atrophy.	Ends expanded.
Medulla	Normal.	Sequestrum, involucrum.	Mottled, circumscribed areas.	Normal.	Normal.	Ends expanded. Narrowed in middle third.
Cortex	Normal.	Affected.	Thin.	Normal.	Normal.	Thickened in middle third. Ends thinned.
Periosteum	Normal.	Affected.	Normal.	Normal.	Normal.	Not affected.
Joint	May be cloudy.	Usually normal unless infection breaks through.	Changes due to malnutrition and secondary deformities. Space widened.	Normal.	Swollen. Hydrops or exudate.	Normal.
Atrophy	—	+ +	From disuse and dystrophy.	Slight.	+ + +	—
Fractures	—	Common especially after operation.	+ + + + Usually unite with fair callus and no displacement.	—	—	+ +
Deformities	Local. May result in shortening.	Common unless prevented.	+ + + Of extremities.	Of various kinds.	+ + + Flexion + + .	From fractures.
Special remarks	Legg-Calvé-Perthes, Osgood-Schlatter's, Köhler's scaphoiditis, Freiberg's infraction, apophysitis os calcis.	Systemic reaction. Fever, leukocytosis.	Ribs fractured. Good callus without displacement.	Disproportion between normal length of body and short extremities.	Relation to Tbc in question. Tonsils and other foci.	A generalized affection of bones.
Special remarks	Scheuermann's, Calvé's vertebral epiphysitis, etc.	Chill, etc. X-ray differs in acute and chronic cases.	Blue sclerotics often associated. Deafness, etc.	Pug nose, prominent abdomen, increased lumbar lordosis.	Glandular involvement. Generalized infection + or — .	May be growth disturbance of length.
Treatment	Orthopedic, immobilization, non-weight bearing.	Early surgery. Drill holes in metaphysis.	Medicinal, dietetic (antirachitic), orthopedic.	Unknown. Orthopedic surgery for deformities.	Physiotherapy. Removal of foci. Orthopedic.	Heliotherapy, diet, hygiene, medicinal.
Prognosis	Good.	Variable.	Poor.	Poor.	Poor.	Poor.

This condition of condensation may be quite marked. The head seems to possess the power to rebuild its structure rapidly, which is in marked contrast to conditions in infectious epiphysitis. Fragmentation of the head of the femur may occur and is analogous to a head made of ice that is struck by the handle of an ice-pick (J. L. Porter).

Cases have been described of similar involvement of other bones and joints. At present it seems fair to state that there is an important group of conditions that have many characteristics in common, viz., Legg-Calvé-Perthes' disease of the hip, Osgood-Schlatter's disease of the upper tibial epiphysis, Köhler's tarsal scaphoiditis, Freiberg's infraction of the metatarsal heads, carpal epiphysitis, apophysitis of the os calcis, Scheuermann's kyphosis dorsalis and Calvé's vertebral epiphysitis. Stern of Cleveland demon-

DIFFERENTIAL DIAGNOSTIC CHART

	Cretinism	Multiple cartilaginous exostoses	Multiple myeloma	Coxa vara	Hemophilia	Coccidioidal granuloma
History	Congenital.	Hereditary + or −.	Flat bones especially ribs, sternum, vertebrae, skull, pelvis.	Congenital, injury, glandular, rachitic.	Familial. Bleeding.	Laborers, males ++.
Age	−	Congenital to any age.		Birth to 15 years.	Any age.	Rare in the young.
Epiphysis	Like rickets.	Normal.	Ends of the bones more prone to be involved in children than in adults.	Flattened slightly and depressed. May slip.	May be swollen.	Cartilage destroyed by direct contiguity and spread of the disease.
Epiphyseal line	Like rickets.	Normal.		Normal.	May be hazy.	
Diaphyseal line	Like rickets.	Metaphysis most common site.	Affected.	Normal.	May be swollen.	
Shaft	Normal except for rachitic changes.	Affected +++.	Usually affected.	Normal.	Normal.	Affected.
Medulla	Normal.	Normal.	Affected.	Normal.	Normal.	Affected.
Cortex	Normal.	Normal.	May be destroyed by expansion or erosion.	Normal.	Normal.	Swelling, then destruction.
Periosteum	Normal.	Normal.	Destroyed by erosion.	Normal.	May be raised by hemorrhage.	Involved late.
Joint	Normal.	Normal.	−	Normal.	Distended by hemorrhage.	Hazy.
Atrophy	−	−	+	−	−	+
Fractures	Common.	Of exostoses occasionally.	Common.	May have slipping of epiphysis.	−	May occur.
Deformities	Common.	Due to exostoses.	+	Due to decreased angle = shortening +.	−	Due to growth.
Special remarks	Cannot be differentiated in X-ray from rickets or achondroplasia.	Exostoses may disappear spontaneously.	Bence-Jones protein in 50% of cases.	Limitation of abduction. Normal angle 110 to 130°.	Transmitted to males through unaffected females.	X-ray findings the same as Tbc, but usually more extensive.
			Punched out holes.			
Special remarks	Skull changes.	Occur in bone formed in cartilage only.	Lesions in children are proportionately larger than in adults.	Coxa vara luxans-dislocation at epiphysis + upward displacement of shaft.		No new bone production. Diagnosis made by laboratory.
Treatment	Thyroid.	Surgical if causing pressure symptoms.	If spine is involved a support is of value.	Orthopedic + general + glandular + or −.	Protein therapy.	Amputation if possible.
Prognosis	Good.	Variable.	Poor.	Good for function.	Varies. Many outgrow the condition.	Poor.

strated a similar condition in the lower tibial and fibular epiphyses. Lewin has seen the condition in the lower femoral and upper humeral epiphyses.

In discussing the etiology of vertebral epiphysitis the last named writer said: "The etiology of this condition is found in the following factors:—Firstly, infection locally and remotely; secondly, circulatory disturbances in the nature of embolism, thrombosis, etc.; thirdly, trauma both internal and external, and fourthly, glandular disturbance affecting bone growth and development."

OSTEOMYELITIS

Osteomyelitis is a blood stream infection usually primary in a distant focus such as the tonsil, mouth and skin. Although any organism may be found, the disease is usually caused by the staphylococcus or streptococcus. If the blood culture is

positive the chances of recovery are poor. Trauma often determines the location of the lesion. The disease is more common in children than in adults as the bone in the child is less resistant and the blood supply to the diaphysis and epiphysis is greater. The disease is probably more common between the ages of two and ten than at any other period; males are more frequently attacked than females. The disease is very common in the upper tibia and lower femur as these regions are subject to many injuries. The upper extremities are less frequently attacked. The epiphysis and the articular surfaces are involved late in the severe types of infection. The epiphyseal line serves as a barrier, therefore the infection extends into the epiphysis and joint in the fulminating types only. In the pure hematogenous types with no history of an injury the diaphyseal line or its close proximity is the favorite site. In the traumatic types it is not uncommon to find the disease in the shaft of the bone, especially in the tibia. The disease starts in the medulla and later extends into the cortex causing destruction of the dense bone and finally affects the periosteum. The cortical portion of the bone derives its blood supply from the vessels of the periosteum and the medullary part from the nutrient arteries.

Fractures may occur in osteomyelitic bones that have been operated upon and considerable bone removed. The degree of deformity depends upon the extent of the process and the correction of the fractures.

In the early diagnosis of osteomyelitis a roentgenogram is usually of very little help. The surgeon must not wait until roentgenographic changes have occurred before operating as very valuable time may be lost. If the infection has existed for some time there may be certain changes in the region of the medulla that will arouse suspicion. The medullary portion of the bone may be hazy and there may be loss of definition in the early stages of the disease, in fact the first roentgenographic sign is thickening rather than absorption. The relative increase in the density may be due to reaction to inflammation such as the influx of leucocytes and a certain amount of edema. Following the increase there will be decrease in the density due to absorption.

There are no signs from the roentgenological standpoint that are characteristic of any type of infection. The roentgenologic diagnosis depends upon the amount of bone destruction and proliferation. There are certain findings accompanying infections that may give one an idea but they are not definitely differential. One must be content to say there is evidence of an infection.

In osteomyelitis of the bones of the hand, oftentimes the findings together with the history may give some clue as to the cause of the infection. In syphilitic and tuberculous dactylitis there are certain clinical findings which when considered with the roentgenograms may be helpful in making a diagnosis. The clinical findings in syphilis are not so severe as roentgenograms would lead one to believe, while in tuberculosis the clinical findings are quite parallel with roentgen-ray findings. In any form of osteomyelitis there often develops a sequestrum and involucrum.

There are a few points that may be of help in the differentiation between malignancy and infectious lesions. It is not uncommon to find areas of normal bone between areas of destruction in osteomyelitis; this is not true of malignancies. If the infection is very virulent there will be extensive bone destruction and no proliferation of new bone. Throughout the medullary cavities vacuolated areas due to absorption can be seen. Between these vacuolated areas there are islands of normal bone in contrast with malignant lesions which start at a central point and usually spread equally in all directions. Another important point in differentiating malignancy is the presence of a sequestrum. In our experience malignant disease never produces sequestra.

In chronic osteomyelitis there is new bone production beginning at the edge of the infection, an effort on the part of nature to limit the process. The bone is not expanded as in benign lesions but is widened by the deposition of new bone on the outside. This proliferation of new bone may entirely obliterate the medullary cavity. If the infection starts in the epi-

physis due to a wound it will spread in all directions and may pass through the joint. This is a valuable differential diagnostic point because in the writers' experience malignant disease does not pass through a joint. The periosteal reaction may also be of importance in distinguishing osteomyelitis from malignancy. In malignant lesions the new bone is usually laid down perpendicular to the shaft while in osteomyelitis it is parallel to the shaft.

OSTEOGENESIS IMPERFECTA (FRAGILITAS OSSIUM) IDIOPATHIC INFANTILE OSTEOPSATHYROSIS

This is a congenital condition characterized by multiple fractures which are usually found in the shafts of the bones; in fact, most of the changes occur in the shafts. The bones are very fragile. While dressing the infant after delivery multiple fracture may occur. As many as 200 fractures have been reported in one patient. The epiphyses are normal, the centers of ossification are also normal. The epiphyseal lines show nothing of importance. There may be some widening although it is not of diagnostic importance. The joint surfaces may show very few changes of importance or there may be a great many changes depending upon the coexisting malnutrition and the amount of deformity present. The diaphyseal line as a rule shows no changes. The cortex of the shaft is usually quite thin accompanied by mottled circumcribed areas in the medulla. In the advanced cases there is usually a great deal of atrophy of disuse. In spite of the numerous fractures there is very rarely much displacement of the fragments because of muscular weakness. Good callus formation with firm union is the rule. Multiple fractures of the ribs are common and union without much displacement usually follows.

Many of these patients have what is known as "blue sclerotics," i.e., a porcelain or china bluish discoloration of the sclera. Not all members of the family having blue sclerotics have fragile bones.

ACHRONDROPLASIA

Achrondroplasia or chondrogenesis imperfecta is characterized by its presence at birth, the disproportion between short extremities and a normal length of body. There is an excess of skin and fat in folds, "pug nose," the hands are short and chubby with fingers of nearly equal length coming off the metacarpals like spokes of a wheel, "trident hand," prominent abdomen and exaggerated lumbar lordosis.

The roentgenologic evidence is most marked in the epiphyses and epiphyseal cartilages, especially of the long bones. The periosteum seems to show no change, consequently no superfluous bone is laid down. While the roentgen findings are quite characteristic there are a number of bone diseases which simulate the changes and may be confused. The changes in the epiphyses often lead to interference with the growth of the bones. The extremities are usually short and at the diaphyseal line there is a band of thickening. In achrondroplasia practically the entire osseous system may be involved. The bones formed in membrane may escape except in the severe cases. Ossification occurs at an early date and it is not uncommon to see complete fusion of the epiphyses in the very young. The ends of all the bones are widened. Changes are noted in the vertebrae characterized by a narrowing of the bodies and roughening of the articular surfaces. The intervertebral spaces are widened. The Haversian canals are usually quite prominent. It is not uncommon to find the fibula too long for the tibia, producing varus deformity.

STILL'S DISEASE

Arthritis deformans in children is characterized by atrophy of bones and deformity of joints which may be extreme. The glandular system is usually involved in that tonsils, regional lymph glands, spleen or liver may be enlarged. It is thought by some to bear a definite relationship to tuberculosis; by others to focal infection such as in the tonsils.

In the case of the writers' under observation at present the condition started three days after the removal of infected tonsils. The bone changes differ from those of the adult in that no exostoses are found.

The roentgen findings are not character-

istic. There is usually a decalcification of the bones making it impossible to obtain good roentgenograms. The joint surfaces are irregular and there is an accompanying narrowing of the spaces around the joints. The soft tissues are swollen. The condition is multiple. The hands, wrists and knees are most often involved. Due to the involvment of the epiphyses which fuse with the diaphyses too early there is stunting of growth.

MARBLE BONES

Marble bones or Marmorknochen (Albers-Schönberg's disease) is characterized by a generalized disturbance of the bony structure, evidenced by a marked, irregularly increased density of some portions of the bones, with thinning and rarefaction in other areas. In the long bones the tendency is toward a marked narrowing of the medullary canals in the middle thirds due to thickening of the cortex, with the ends of the shaft presenting an expanded appearance, with a thinning of the cortex and a coarsely mottled effect due to increased density in the marrow cavity. The small bones, such as vertebrae, carpals, and tarsals, present a generalized increased density, with absence of bone structure, The epiphyseal lines have slightly irregular margins. There is a general increase of density of the epiphyses with absence of bony structure but of normal size and outline. There may be growth disturbance of the bone length.

CRETINISM

The important points in the differential diagnosis in cretinism are the facial expression, the dryness of the skin and appendages, viz., the hair and nails, the small size or absence of the thyroid gland. In the roentgenogram it is impossible to differentiate cretinism from rickets or achrondroplasia. Recently Schwartz of Milwaukee had an interesting typical example of this condition.

MULTIPLE CARTILAGINOUS EXOSTOSES OR HEREDITARY DEFORMING CHONDRODYSPLASIA

This condition, which has recently been given the name diaphyseal aclasis by Sir Arthur Keith, is manifested by a history of tumor masses occurring at birth or during early childhood, most commonly in the region of the knee joint.

The most prominent findings are the exostoses. They are usually painless unless traumatized or producing pressure on neighboring structures. During a period of rapid growth they may be tender or sensitive. Deformity may be produced especially in the forearm or leg due to curvature of bone. The result of unequal bone growth where two long bones are parallel and connected by an interosseous membrane is a deformity. In the forearm there is produced a manus varus or valgus, depending upon the bone affected. Injury to the exostosis may result in bruising, fracture or hematoma formation.

ENCHONDROMA

Enchrondromata are benign bone tumors which may affect any of the bones formed in cartilage. They are usually multiple and do not produce much pain.

MULTIPLE MYELOMA

Multiple myeloma is uncommon in childhood although several cases have been reported. The condition is similar to that found in adults except that the lesions are usually comparatively larger. Any bone in the body may be affected even to the skull and vertebrae. Many cases are first recognized by roentgenograms of spines taken for indefinite symptoms. These changes differ from metastatic malignancies in that they do not invade, and destroy cortex only by expansion. Bence-Jones' bodies are found in the urine in about 50 per cent of cases.

TUMORS

Tumors in infancy and childhood are usually hypernephroma and are highly malignant. Sarcomatosis occurs in childhood and is highly malignant.

TYPHOID AND TYPHUS

Typhoid and typhus fevers are rare and their bone changes are seen very infrequently and are mentioned merely in passing.

INFANTILE OSTEOMALACIA

Infantile osteomalacia is a very uncommon condition in this country. The relationship of this condition to osteoporosis or nutritional osteopathy has been brought out by some of the European writers who have described many cases of this condition due to the starvation or practical starvation of the children during the war and the period following. Most of these cases have been reported from Austria and Germany.

Infantile osteomalacia differs from the adult type in that there are definite changes in the bones of the skull while in the adult type the skull is not involved. This generalized decalcification of the bones is noted as in adult cases. Fractures are of frequent occurrence.

INFECTIOUS PERIOSTITIS

Infectious periostitis is a condition, as its name indicates, probably due to infected emboli involving the nutrient vessels of the periosteum or it may be due to injury. Osteomyelitis may or may not accompany this condition.

ASEPTIC NECROSIS

Aseptic necrosis, a condition described by Phemister, will not be discussed in this paper.

COCCIDIOIDAL GRANULOMA

Coccidioidal granuloma is a disease caused by *Coccidioides immitis* commonly called "California disease." It is often confused with blastomycosis. The two diseases can be differentiated only by culture as each have definite cultural characteristics. The blastomycetes show definite budding whereas the coccidioides produce endospores. There have been about 45 cases of the latter condition reported, 40 of which occurred in the San Joaquin Valley. The writers' case lived in the Valley for some time. The disease is prone to develop in laborers, especially males. There is only one case in a female, reported in the literature. The case here reported makes the second. The disease usually starts in the skin of the feet and hands and produces papules, nodules and later ulcers which break down. The lesions are quite similar to those of tuberculosis and syphilis. The findings from both the pathological and the roentgenological standpoints are very similar to tuberculosis. The nodules, according to Hektoen, cannot be differentiated from those of tuberculosis. In some of the cases the disease was thought to have started in the lungs. The disease is accompanied by an adenitis which is not true of blastomycosis. Meningitis is prone to develop during the course of the disease. There is usually a great loss in weight accompanied by fever and a high leucocyte count. According to the literature there have been three recoveries, in every case of which the lesions were in the extremities where amputation was performed. The writers' case is still alive and seems to be holding her own although roentgenological changes in the lungs are progressing. The bone changes are very similar to those seen in tuberculosis. There is a definite area of destruction in the first metacarpal and one in the patella. The process has not destroyed the cortex but there seems to be some swelling of that structure. The process so far has not extended into the joint surfaces. In the center of one of the metacarpals there is a large area which has the appearance of very soft bone. So far in the development of the disease there has been no evidence of new bone formation. In the patella the process seems confined to the medullary part of the bone with no evidence of invasion or new bone formation. The lungs are studded with many small circular areas of increased density not unlike a disseminated tuberculosis. At the first chest examination nothing of importance could be seen in either lung. Since that time there has been a gradual increase in the small tubercle-like areas.

When the first roentgenologic examination of the metacarpals was made the lesion was thought to be either a syphilitic or a tuberculous dactylitis. At a later date the skin lesion on the knee was opened and smears taken. Dr. E. Hirsch, the pathologist, thought the condition was due to *Blastomycosis* but after culturing found the endospores of *Coccidioides immitis* and made the definite diagnosis.

After frequent examination of the patient

and careful studies of the films one is still unable to see anything of definite differential diagnostic value. The patient is a negro girl ten years of age referred by Dr. S. C. Plummer.

COXA VARA

Coxa vara is characterized by a history of the deformity either from birth or the result of accident. The angle of the neck and shaft of the femur is markedly diminished from its usual degree of 110 to 130. There may accompany this condition a slipping of the epiphysis. There is usually no bone destruction and very little atrophy because the condition is usually not painful and therefore weight-bearing is continued.

HEMOPHILIA

Hemophilia is characterized by the history of familial bleeding. The condition is usually transmitted to the males through unaffected females. The findings consist of extravasation of blood into the joint without definite bone changes. Soft tissues are markedly stretched and therefore hypermobility of the joint may result.

ABSTRACT OF DISCUSSION

Dr. Edward L. Jenkinson (Chicago) referred to illustrations of the bone lesions of coccidioidal granuloma in "Bone and Joint Diseases" by Baetjer and Waters which show changes in the tibia near the ankle joint. In a case of his own the bone changes were confined to the first metacarpal and the patella, and there were in addition pathological changes in the lungs. This patient showed improvement under roentgen therapy. Dr. Jenkinson called attention to the apparent decrease in the incidence of scurvy which he attributed to the probable fact that the average mother knows more about proper diet for children than was formerly the case. He thinks that the same holds true for rickets.

Dr. Wm. B. Bowman (Los Angeles) stated that the statistics given by the authors are probably somewhat misleading with regard to the frequency of coccidioidal granuloma. In California the disease is so common that cases are no longer reported in the literature. Usually the cases are first diagnosed as tuberculosis. He was led to treat the disease with the roentgen ray because of the resemblance of its lesions to those of blastomycosis, and he reported several cases so treated with beneficial but not curative results.

Dr. H. K. Pancoast (Philadelphia) reported a case of coccidioidal granuloma of the glands in the neck which had occurred after a tonsillotomy in Los Angeles. The condition extended to the mediastinum and greatly resembled Hodgkin's disease. Microscopic examination of the glands proved the diagnosis. None of the bones were affected. Potassium iodide and roentgen treatment failed to benefit.

Dr. Edward Blaine (Chicago) spoke of the inaccurate terminology of many bone diseases. "Osteogenesis imperfecta" for instance, means imperfect bone development and might be applied to a considerable number of diseases in which the bones do not develop in a normal manner. The term "osteopsathyrosis" is more accurate when the imperfectly developed bones show a tendency to crumbling. The achondroplasias are also instances of imperfect development.

Dr. A. C. Christie (Washington, D. C.) asked Dr. Lewin if he knew of any way to make a differential diagnosis between syphilitic and tuberculous dactylitis. It is stated correctly that syphilitic dactylitis is likely to be multiple, and tuberculous dactylitis is more likely to involve only one bone, and if there is sinus formation it is more likely to be tuberculous, and if periostitis is marked it is probably syphilitic but all of these criteria are so variable as to make them of little value. In syphilitic dactylitis it is not very uncommon to have sinus formation, and in this disease it occasionally involves only one instead of several bones. The entire bone is usually involved when we first see it so that we have no indication as to whether the disease began in an extremity, as is usually the case in tuberculosis, or in the shaft as usually happens in syphilis.

Dr. Christie said that he thought it very unfortunate that Köhler's name should be attached to two distinct diseases in the foot, one an osteochondritis of the scaphoid bone and the other of the head of the second metatarsus. Freiberg of Cincinnati described this second disease in 1914, years before it was described by Köhler and if a man's name is to be used to designate it, it should be called Freiberg's infraction. Freiberg, however, has lately written an article on the subject in which he states that the original lesion is not a fracture but that there is probably deformity of the bone before the infraction occurs.

Dr. A. H. Pirie (Montreal) suggested that in cases of osteogenesis imperfecta since the bones seemed to be stronger in the healed areas of old fractures it might be of value to produce multiple fractures artificially in order to secure the extensive deposition of bone salts throughout the entire bone involved.

Dr. L. T. LeWald (New York City) showed a lantern slide of a spinal deformity in a child in which there was a narrowing of one vertebra, with no changes suggesting tuberculosis. He believed it to be a case of kyphosis juvenilis or vertebral epiphysitis. This disease is more common in boys, however, and Dr. LeWald's case was a girl.

A REVIEW OF FOUR HUNDRED AND FIFTY ROENTGEN-RAY EXAMINATIONS OF THE SHOULDER

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WHY is the roentgen examination negative in such a large number of shoulder cases? Endeavoring to answer this question we reviewed the roentgen examination of all shoulder cases seen in the Roentgen Department of the Massachusetts General Hospital from January 1, 1925 to June 1, 1926. The plates and interpretations were available in all cases. The House history, the Out-Patient Department history or both were available in all but a few cases, which were seen only in the emergency ward. The more recent cases could still be studied in the House or Out-Patient Department.

The tabulated statistics, given below, furnish several points of interest.

	No. of Cases		Percentage of Cases	
Arthritis	20		4.4	
Tuberculous		5		1.1
Luetic		1		0.2
Hypertrophic		3		0.6
Infectious		3		0.6
Acrom-Clav		8		1.7
Fractures and dislocations	97		23.3	
Frac. head other than greater tuberosity		9		1.9
Frac. acromium		1		0.2
Frac. glenoid		1		0.2
Frac. gr. tuberosity (uncomplicated)		52		11.4
Frac. gr. tuberosity + relaxed capsule		1		0.2
Frac. gr. tuberosity + dislocation		8		1.7
Dislocation, uncomplicated		22		4.8
Separation ac-clav. joint		3		0.6
Relaxed capsule	1		0.2	
Old fracture scap. with spot atrophy	1		0.2	
Bursitis subacromial	13		2.8	
Periarthritis	6		1.3	
Post-op. deformity malignancy	1		0.2	
Deformity, birth palsy	2		0.4	
Foreign body	2		0.4	
Old traumatic	4		0.8	
Osteomyelitis	2		0.4	
Myositis ossificans	1		0.2	
Negative	300		66.6	

The 5 cases in which the roentgen interpretation of tuberculosis was made were all proven so by biopsy. In one case the roentgen examination suggested lues. There seemed to be less bone atrophy in shoulder tuberculosis than occurred about other tuberculous joints. Allison and Brooks[1] have shown that the degree of atrophy is directly proportional to the degree of non-use, regardless of the cause. The shoulder joint lends itself less readily to complete immobilization than most other joints. This furnishes, we believe, a logical explanation for the comparatively small amount of atrophy in tuberculous shoulders. It may also be of interest that all of these cases were past the adolescent age. Jones and Lovett[2] call attention to its rarity in all ages, but particularly in children. They cite the work of Sever,[3] who found 17 cases in 7,474 tuberculous spines and joints examined at the Boston Children's Hospital.

There are 3 cases each of type one and type two arthritis. The type two cases were diagnosed from hypertrophic changes, which occurred at the attachment of the capsule, and may have been extra-articular. The type one cases were quite definite, both roentgenologically and clinically. They were all cases of at least fifteen years' duration, and the shoulder involvement was part of a generalized ankylosing

process involving most of the major joints. We believe that the roentgen ray has missed, and will continue to miss, most of the cases of shoulder arthritis. The following case is cited:

Mrs. L. P., aged fifty-seven. Eight months previous to admission, both knees became swollen, stiff and painful. During the next two weeks the hips, shoulders, elbows and spine were similarly involved. She has been unable to work since that time. On admission there was marked limitation in motion of all these joints with tenderness along the joint lines. Roentgenograms showed only some atrophy of the humeri. A tonsillectomy was performed because of a history of repeated tonsillitis. She was treated with abdominal massage, colonic irrigations and physiotherapy. Six weeks later she was discharged to her local physician, considerably relieved, but with some persistent limitation in joint motion.

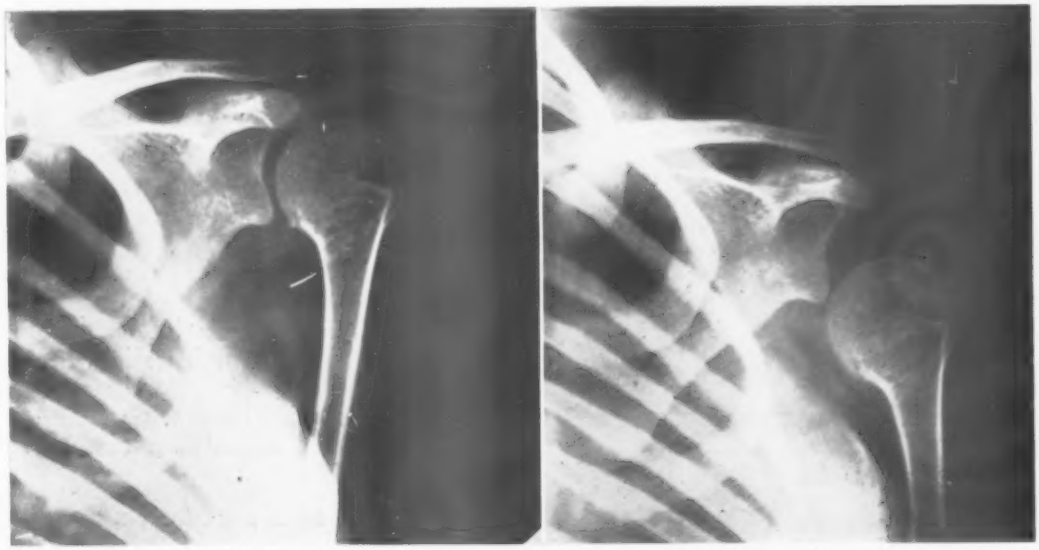

FIG. 1*a*. FIG. 1*b*.

FIG. 1. Case of relaxed capsule. Both films were taken in the same position, without moving the tube or patient. Slight traction was applied to the arm in *b*.

It is only fair to suppose that this case is one of shoulder arthritis. There are a number of such cases classed in this series as negative, though some of them show moderate bone atrophy. Why can't we show arthritic changes in the shoulder by roentgen rays? For easily understood anatomical reasons it is difficult to show by roentgen rays, (1) the increase in joint fluid with separation of joint cartilage; (2) close approximation of bone to bone due to cartilage destruction, and (3) destruction or proliferation of bone, involving either the convex surface of the head of the humerus or the concave surface of the glenoid. One cannot show in outline the varied surfaces of the bones making up this joint. In an acutely painful joint it is almost impossible to get both the anteroposterior and lateral views. Arthritis may not give the gross changes in the shoulder that we see in arthritis involving other joints because, first, it is not a weight bearing joint. Irritating and destructive cartilage to cartilage pressure is limited, except under unusual conditions, to the combined power of the deltoid and supraspinatus, the latter a weak, but important muscle; second, the capsule is sufficiently large to contain the heads of two humeri. With effusion into the joint a protective mechanism has been established which will aid in preventing cartilage friction. A great amount of fluid would be necessary for detrimental pressure on the joint surfaces.

Fracture of the greater tuberosity furnished a rather high number of the positive cases. We believe it to be a very

common injury easily over-looked in the roentgen examination. It is interesting to note how frequently it is associated with dislocation. Those cases in which there is but a small fragment of the greater tuberosity torn away can probably be explained by (1) the sudden and violent adduction of the arm in the attempt of the individual to stay his fall, or (2) the dislocation occurs suddenly with the supraspinatus still contracted in a protective spasm, and thus a great pull is suddenly

FIG. 2. Bone atrophy following accident resulting in paralysis of muscles of entire arm. Note the resemblance to Figure 3, a case of metastatic carcinoma.

exerted on the attachment of the supraspinatus to the tuberosity. It is possible that a tearing away of the entire greater tuberosity may be explained in the same way. However we believe it is more reasonable to suppose that they are caused either by direct violence from the outside, or by trauma against first, the acromium and clavicle as the head of the humerus is forcible thrown through the capsule, or second, against the glenoid when the head passes from the subglenoid to the subcoracoid position.

There were 13 cases diagnosed subacromial bursitis from the roentgen examination. Most observers believe that the shadow seen in the plate involves the supraspinatus tendon rather than the bursae. Painter,[4] however, has removed from the bursae lime salts in crystalline form. It is quite probable that some of these shadows represent insertion fractures of the supraspinatus. Such fractures might be negative in the roentgenogram for several weeks after injury, that is, until there has been proliferation by the fragment of periosteum. The subdeltoid bursae is so intimately placed with the supraspinatus tendon, the greater tuberosity, the acromio-clavicular joint and the true shoulder joint, that any marked inflammatory condition in this neighborhood will cause bursal irritation. A diagnosis of subacromial bursitis may then only be a diagnosis of a condition concomitant to more important pathology.

There are 6 cases of "periarthritis." We use this term for want of a better one. These cases showed slight hypertrophic changes at the capsular insertion. Most of them also showed calcification in the region of the subacromial bursae. One case was referred into the house as a case of subacromial bursitis:

> P. F., white, male, aged forty-eight, gave a history of pain and disability of the right shoulder for five years. More recently there has appeared a similar condition in the left shoulder, both knees and low back. The pain was worse in the morning and tended toward improvement with activity. Roentgen examination showed calcification in the region of the subacromial bursae as well as very slight hypertrophic changes at the inferior border of the glenoid. After study in the house he was discharged with a diagnosis of arthritis.

It is this type of case, which is frequently wrongly diagnosed subacromial bursitis. Treated as bursitis with a period of rest, baking, massage and then graded exercises he will, of course, show improvement. We then falsely conclude that it must be a subacromial bursitis.

There were 3 cases showing markedly relaxed capsules.[5,6] The case with a fracture of the greater tuberosity was at first thought to be a dislocation until attention was called to the true condition by the

roentgen department. A second case is not classed as such in the table, but is one of the cases of osteomyelitis which developed two months after the reduction of a dislocation. The third case is shown in Figure 1.

There are, in this series, 300 negatives, two-thirds of all the cases. In explaining this high figure, let us consider first, the varied causes of shoulder pain. The causes[7] other than shoulder lesions are:

1. Cardiovascular lesions, angina, aortitis, aneurysm, coronary sclerosis.
2. Pleural, pulmonary and mediastinal. Pleurisy, pneumonia, intrathoracic new growth, pneumothorax.
3. Abdominal lesions, gastritis, gastric ulcer or carcinoma, gall-bladder disease, hepatic or subphrenic abscess, pneumoperitoneum, ascites, rupture of ectopic pregnancy.
4. Neurological lesions, hemiplegia, new growth, cervical Pott's disease, cervical arthritis, cervical ribs, herpes.

Let it be remembered that these lesions can not only cause pain referred to the shoulder, but when severe will cause limitation in motion and localized tenderness, followed by atrophy of the muscles about the shoulder, moderate capsular relaxation and continued or increasing disability.

The more common shoulder lesions causing pain and disability are:

A. Those not demonstrable by roentgen rays:
   - Postural[8]
   - Sub-coracoid bursitis[9]
   - Tenosynovitis biceps
   - Myositis—traumatic and infectious
   - Attrition—slight to moderate[10]
   - Relaxed capsule—slight to moderate
   - Tight axillary capsule[11]

B. Those that may be demonstrable by roentgen rays:
   - Fractures
   - Dislocations
   - Sepsis
   - Foreign bodies
   - Tuberculosis
   - Lues
   - Arthritis
   - Separation acromio-clavicular joint
   - Relaxed capsule extreme
   - Attrition extreme
   - Subacromial bursitis

What technique can we use and how may we alter it to show these varied lesions? With the patient face up on the Bucky diaphragm, a plumb should be used for accurate centering. The patient should be instructed to hold his breath while the exposure is being made, in order to prevent motion. Both a slightly under- and a normally exposed film should be made with the arms in extreme external rotation. Stereoscopic views may be indicated. The glenoid may be shown in outline by centering 4 inches medial to the coracoid and directing the tube toward it. If the shoulder can be abducted a plate may be taken through the axilla. The other shoulder should always be taken for comparison.

Fig. 3. Metastatic carcinoma.

Fractures of the greater tuberosity are certainly too frequently missed by not taking a plate with the arm in complete external rotation. Insertion fractures of the supraspinatus as well as subacromial bursitis may be missed by not taking a soft film in external rotation. Stereoscopic views are of particular value in arthritis, tuberculosis, lues and relaxed capsule. A plate showing the glenoid[12] in outline may be of value where arthritis is suspected. Separation of the acromio-clavicular joint, a moderately relaxed capsule, and attrition will not be diagnosed correctly unless all plates are taken in the same plane. This can only be done by using some method, such as a plumb and bob, for accurate

centering. Destruction of joint cartilage may be shown on a film taken with the humerus pressed against the glenoid. It has been suggested[13] that one film may be used in cases of shoulder pain. It should be sufficiently large and so placed as to show the cervical spine, upper mediastinum, and upper quadrant of the chest.

CONCLUSIONS

To reduce the number of negative roentgen examinations of the shoulder:

1. The cause of referred shoulder pain should be found by thorough examination.
2. Both under-exposed and normal films should always be taken with the arm in external rotation.
3. The tube should always be accurately centered.
4. Relaxed capsule will not show unless some force is used to pull the head of the humerus away from the glenoid.

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REPORT OF A CASE OF GENERALIZED CARCINOMATOUS METASTASIS OF THE BONES

BY M. A. WALKER, M.D.

DILLON, MONTANA

MRS. H. O., aged forty-five, married at twenty years of age, and has been living with husband most of the time since. She has never been pregnant. Until August, 1925, menstruation has been regular, painless and of average amount.

At about fourteen years of age, she noticed a slowly increasing curvature of the upper dorsal spine. This was accompanied by a moderate amount of pain, although no physician was consulted in regard to it. The curvature increased for about eighteen months, since then remaining stationary and painless.

Appendectomy several years ago. She had typhoid in 1910, recovering without complications. There is no history of fracture or malacia, and no other history of importance until last year. The family history is entirely negative.

Until August, 1925, her health was good and weight about 170 pounds. At that time she began to restrict her diet for the purpose of reducing weight. In a few weeks her weight had come down to about 155 pounds. At about that time, she discovered a small painless and insensitive lump in the left breast, which she says was freely movable and not accompanied by any dimpling of the skin.

FIG. 1. Left shoulder. Well-defined areas of diminished density in all bones.

FIG. 2. Right shoulder, showing absorption of cortex, upper end of humerus.

In December, 1925, on account of increasing weakness and loss of flesh, the patient entered a hospital in a small Minnesota city. While there, in February, 1926, the surgeon removed her left breast and axillary glands, which he said was for "a carcinoma about as large as a dollar" though no microscopic examination was made of the growth.

This patient was first seen by me

April 1, 1926, having been sent by the hospital authorities to relatives living in this vicinity.

At this time her principal complaint was of a very severe stomatitis, so that she could not even drink liquids without the aid of a tube. Investigation revealed that for a short time she had been given some yellow pills, but soon after, the

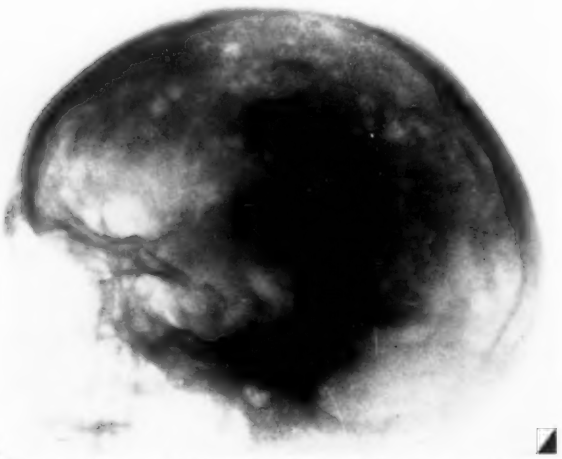

FIG. 3. Areas of absorption in cranial bones, with no thickening perceptible.

mouth became sore, and they were discontinued. The stomatitis was undoubtedly mercurial, as with ordinary care the condition completely cleared up in a few weeks.

Her weight on entrance to this hospital was 96¼ pounds, height 72 inches. She was sallow and cachectic in appearance, and very weak. The temperature and respiration were normal, pulse rate about 90. There was a linear scar from the breast operation, which had apparently healed without complication or delay.

Dental examination showed a severe case of pyorrhea. There were no palpable glands, except the right submaxillary, which was considerably enlarged and tender, probably from oral absorption. Heart and lungs were normal. She gave no history of venereal infection, though there was a positive Wassermann reaction with cholesterinized antigen.

Blood count showed: leucocytes 7,200, red blood cells 3,400,000; hemoglobin 72 per cent; neutrophiles 51 per cent, basophiles 1 per cent, eosinophiles 1 per cent, large lymphocytes 19 per cent and small lymphocytes 28 per cent.

Several urinalyses showed entirely normal urine with respect to albumin and sugar, and no Bence-Jones bodies. There was polyuria, a number of 24-hour examinations giving an average amount of 2,400 c.c. with a sp. gr. of 1010.

FIG. 4. Showing condition present in pelvis and femur.

The patient complained of moderate intermittent pain in the right subscapular region. This was only sufficient to call for the use of a single dose of sedative perhaps every other night. There were also some other ill-defined pains in various parts of the torso and upper extremities.

Roentgenographic examination of the thorax showed no abnormality of its contents. On the examination of this negative, the condition of the bones was first discovered.

All bones in the field of this roentgenogram showed the presence of almost innumerable circular or oval areas of diminished density, having well-defined smooth margins (Fig. 1). There is no evidence of attempted repair of any of these areas. They vary in size from a few millimeters up to about 20 mm. in diameter. In some instances the areas have distended the cortex of the bone, and in a few places have broken through it, notably in the ribs and on the outer surface of the head of the right humerus (Fig. 2).

The same condition exists in all the bones except those of the hands, feet and distal halves of the forearms and legs. There is no evidence of the process having begun near the points of entrance of the nutrient vessels. There is no thickening of the cranial bones (Fig. 3), but these, with the mandible, vertebrae and pelvic bones seem about equally involved (Fig. 4). The pituitary fossa is normal but small. In none of the affected bones is there any evidence of attempted repair, nor of any bending or fracture of any of the long bones. There seems to be some tendency toward symmetrical distribution of the lesions (Fig. 5).

Lateral roentgenograms of the upper dorsal region show the kyphosis to be due to the crushing of the bodies of the 3d and 4th dorsal vertebrae, with no sign of active or recent pathological condition.

The patient was discharged from the hospital May 18, 1926, much improved in general condition, being able to walk about the building with comfort. Her weight at this time was 107 pounds. No treatment of any kind was attempted beyond the use of simple care for the mouth condition, and the extraction of all her teeth.

After her discharge from the hospital, I did not see this patient for a long time, though occasional reports showed continuous deterioration of her general condition. The indefinite pains of which she had complained did not increase in severity.

On December 10, I saw her at her home. She was then practically moribund, and died on December 15, 1926.

FIG. 5. Both elbows. Note tendency toward symmetrical distribution.

Complete autopsy was not obtainable, but a specimen of bone from the upper end of the humerus was removed and sent to Dr. Joseph Colt Bloodgood for examination.

His report to me was that the tumors were typical of adenocarcinoma.

HUNGER PAIN*

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THE mechanism of hunger has been of great interest to scientists for many years. Haller[1] wrote rather extensively on the subject one hundred and fifty years ago, and many articles have appeared in the physiological literature since his time.

The presence of contractions in the fasting stomach was demonstrated by Boldireff[2] in 1904. After inserting an inflated balloon into the stomach of a fasting dog, he was able to show variations of intragastric pressure with the aid of a recording manometer connected with the balloon by means of a rubber tube. However, he did not associate these contractions with the hunger sensation.

In 1911 Cannon and Washburn[3] performed similar experiments on man. The subject swallowed a balloon which was attached to a small rubber tube. The balloon was inflated and the tube was connected to a recording manometer which traced the variations of intragastric pressure on a revolving drum. The arrangement of the apparatus is illustrated in Figure 1. These workers showed that the recurrent epigastric pain occurring during hunger is definitely associated with contractions of the stomach.

Carlson[4] and his associates have used the method of Cannon and Washburn in making an extensive study of the behavior of the fasting stomach in man and animals. It is Carlson's opinion that the hunger sensation is due to the stimulation of sensory nerves in the submucosa or muscularis by certain types of gastric contractions. He has shown that the activity of the empty stomach occurs in cycles. After a period of rest, weak single contractions lasting about thirty seconds appear at wide intervals. These are known as Type I contractions. If the tonus of the stomach remains feeble these waves may gradually die out, but if the tonus increases, as it often does after the onset of activity, the contractions become more vigorous and appear at shorter intervals. These more vigorous waves are known as Type II contractions. Following the increased activity the tonus may increase still more so that the stomach appears to go into tetanus. During this period waves of short amplitude, which are known as Type III

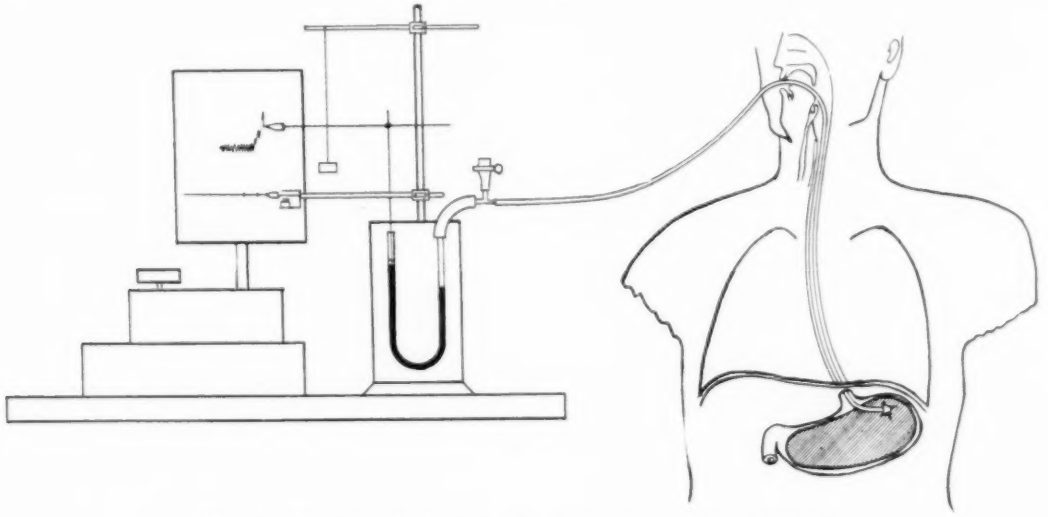

FIG. 1. Diagram showing arrangement of recording apparatus.

* Read at the Twenty-seventh Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Detroit, Mich., May, 17–21, 1926.

contractions, appear. After such a cycle, the stomach relaxes and shows no activity for a time, but after an interval the same phenomena will recur.

inside of a second balloon and a paste made of bismuth and vaseline was placed between their walls. The double walled balloon was attached to a tube, swallowed

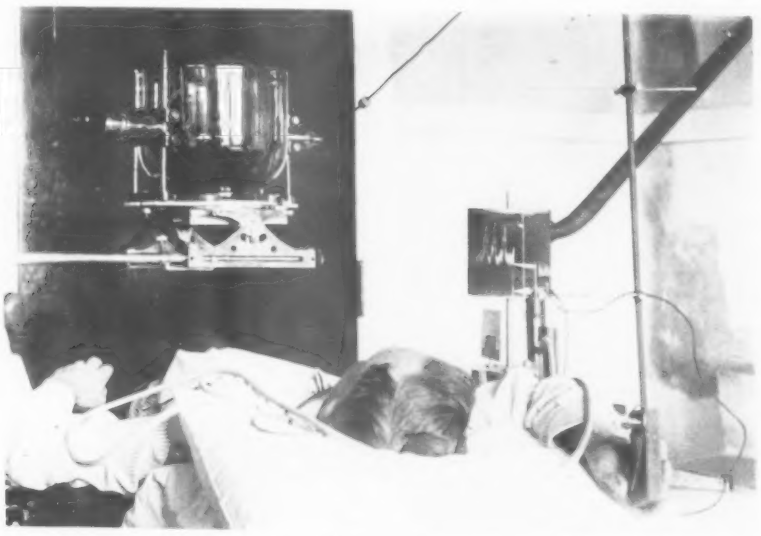

FIG. 2. Photograph showing subject in position during actual experiment. Note the hunger contractions on the recording drum.

Although the recording manometer indicates accurately the relative amplitude and periodicity of the contractions, it

and blown up in the regular way by one of us (R), after which roentgenograms of the stomach were made during hunger

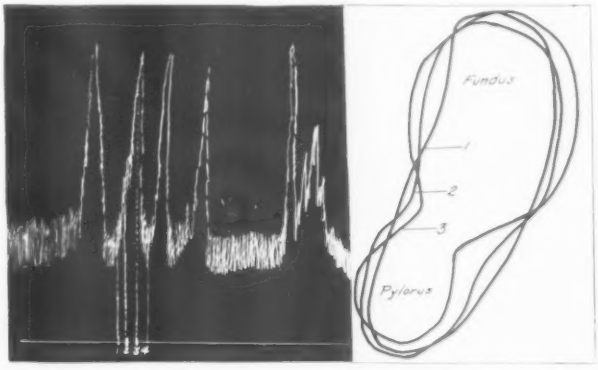

FIG. 3.

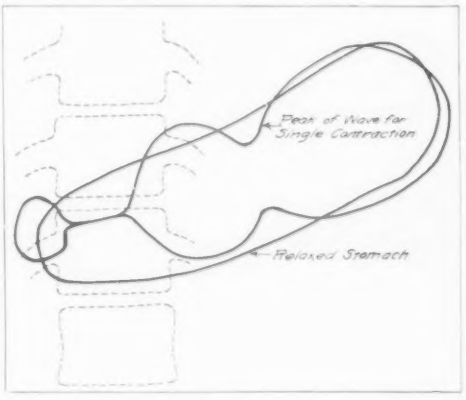

FIG. 4.

FIG. 3. Superimposed tracings from roentgenograms of the stomach made during three different phases of a hunger contraction as indicated on the kymographic tracing. (Reproduced from *Am. J. Physiol.*, 1926, lxxvi, 351.)

FIG. 4. Tracings showing the shape of the stomach at the peak of an unusually strong hunger contraction.

gives no information regarding the contour of the stomach during hunger.

In 1915 Rogers and Hardt[3] attempted to study the gastric contour during hunger contractions. One balloon was placed

contractions. It was the opinion of these observers that the activity of the stomach consisted simply of hyperperistalsis.

However, the bismuth coated balloon is quite heavy and it seems hardly fair to

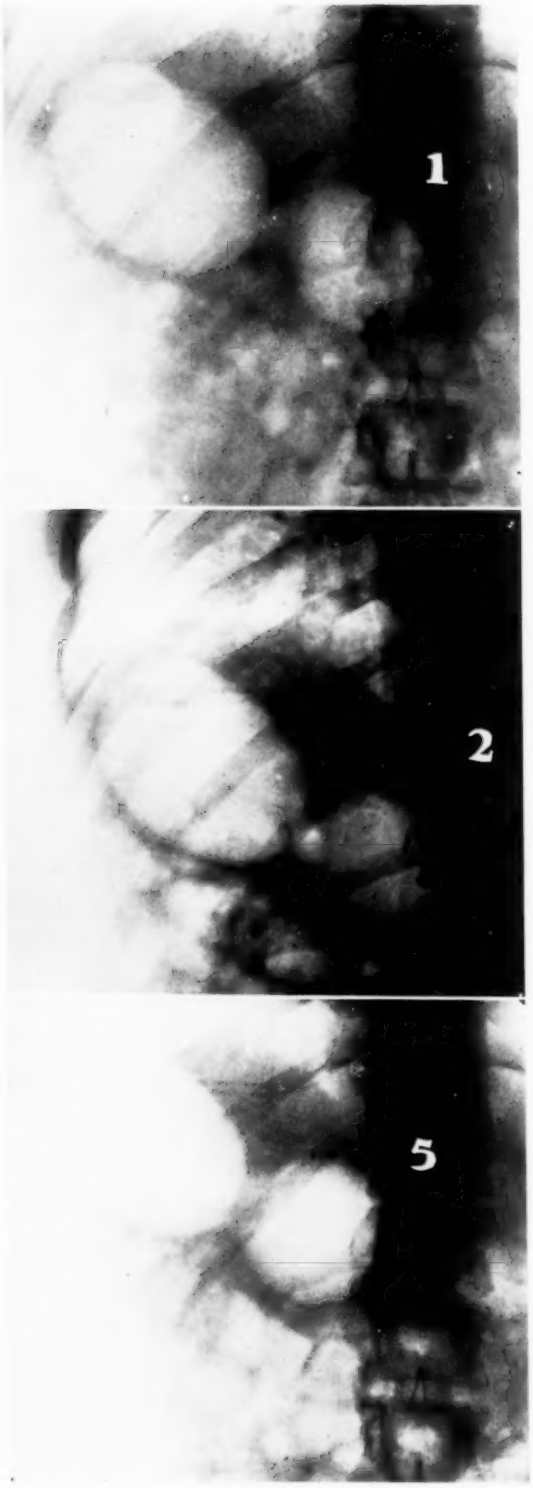

FIG. 5. Several actual roentgenograms showing different phases of hunger contractions.

speak of a stomach containing such a balloon as a fasting stomach. We, therefore, have made roentgenograms of a single air-filled balloon in the fasting stomach during hunger contractions. Our preliminary paper[6] describes the technique and some of our earlier results. Our apparatus was arranged as shown in Figure 1. A recording magnet was connected with a switch held in the hand of the subject (R) so that a mark could be made on the drum each time a roentgenogram was taken. By erecting perpendicular lines on the tracings from these marks to the curves it was possible to identify the point on the curve represented by each roentgenogram. After the recording apparatus was arranged the subject lay in a supine position (Fig. 2) on the Bucky diaphragm and films of the stomach were made at intervals in an effort to bring out the various changes in its contour. Half second exposures were used at an 8 inch spark gap with 30 milliamperes flowing through a fine focus Universal Coolidge tube. A filter of 0.5 mm. of aluminum was placed beneath the tube. For such experiments to be successful, the subject must be able to swallow the balloon without any nausea or gagging and he should be made as comfortable as possible on the table. Our best tracings were obtained after fasts lasting from eighteen to twenty-four hours. Much patience is required, since under these conditions the periods of absolute gastric relaxation are sometimes quite lengthy. Roentgenoscopic observation of the motor phenomena would seem preferable to the roentgenographic method but we found it impossible to get clear roentgenoscopic images of the contracting air-filled stomach.

By working very rapidly four roentgenograms were obtained during a single hunger contraction as shown in Figure 3. The outlines of the stomach in the first three films taken are superimposed. No. 4 is omitted since it is a duplicate of No. 1. From these findings it would appear that the hunger contraction consists of a single constriction near the junction of the media and the antrum, rather than a hyperperistalsis as suggested by Rogers and Hardt. Carlson[7] has expressed the belief that this phenomenon consists of a tonic con-

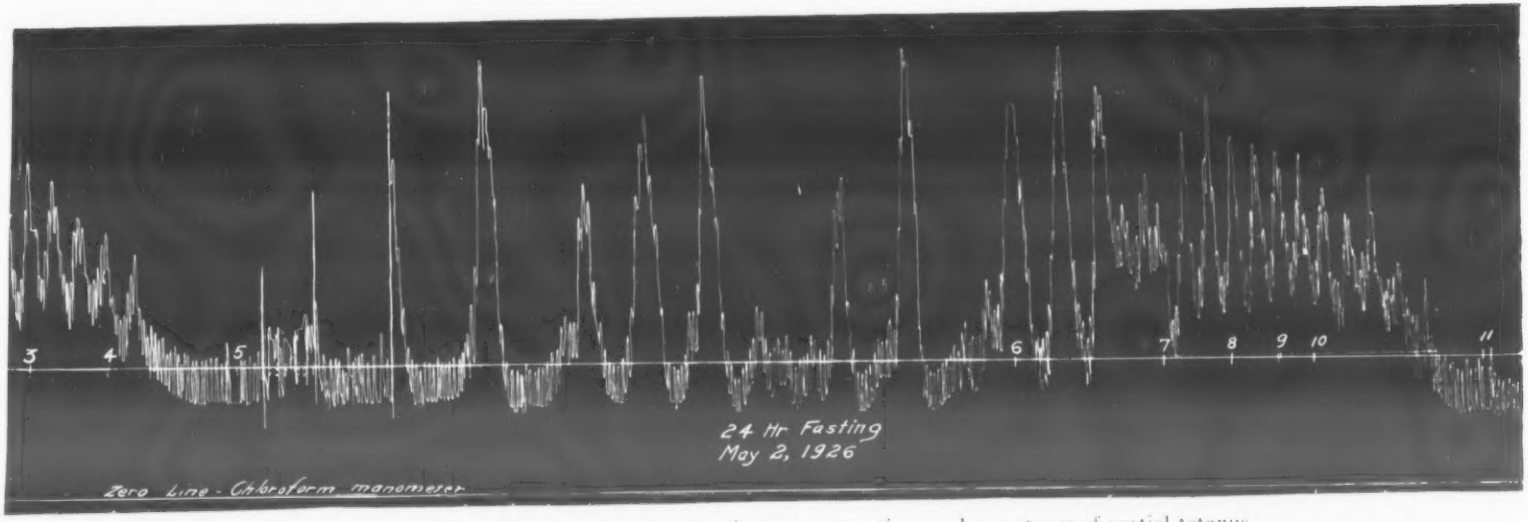

FIG. 6. Kymographic tracing showing numerous hunger contractions and two stages of partial tetanus.

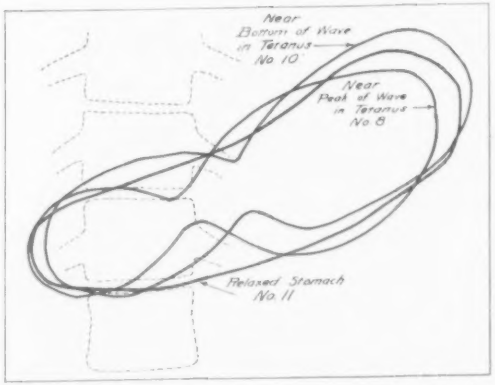

FIG. 7. Tracings from roentgenograms of the stomach made during partial tetanus.

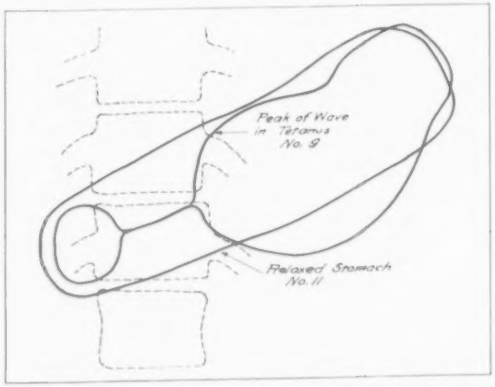

FIG. 8. Tracing of stomach at the peak of a contraction wave during partial tetanus.

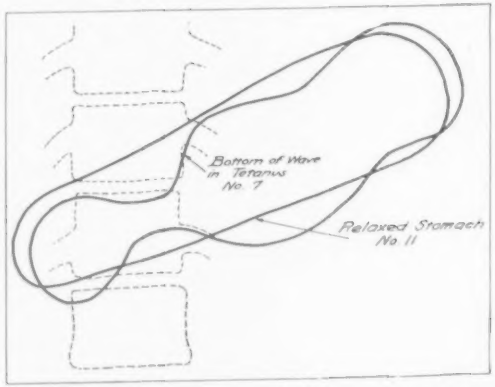

FIG. 9. Tracing of stomach from roentgenogram made at the bottom of a contraction wave during partial tetanus.

traction, but he placed it in the fundus rather than in the antrum of the stomach. In some of the films studied a second contraction of slight depth has been observed in the upper portion of the stomach during the height of a hunger contraction, but the contraction of the lower end of the stomach is invariably present. The tracing of the contracted stomach shown in Figure 4 was taken from a roentgenogram made at the extreme peak of an unusually strong contraction wave accompanied by severe epigastric discomfort. It shows the secondary wave in the fundus. However, many of the films showed only the single tonic contraction in the lower end of the stomach. Several illustrations of this phenomenon are reproduced in Figure 5. From these findings, we are forced to the conclusion that the pain occurring in the epigastrium during hunger is associated with a localized constriction in the antrum of the stomach.

Further experiments were performed in an effort to study the stomach during the stage of tetanus within which the contractions occur rather rapidly, but have a short amplitude. The recording point does not drop to the usual level after each contraction, but remains elevated probably as a result of an increased tonus. Figure 6 illustrates one complete stage of partial tetanus and part of another one. Tracings from films made during the tetanic period are shown in Figures 7, 8 and 9. The constriction of the antrum shown in Figure 8 indicates that the peak of the wave during this period is caused by the same changes as were described for the single contraction. Tracing No. 10 in Figure 7 shows that the stomach is not completely relaxed at the bottom of the contraction wave and indicates that the increased tonus consists simply of a failure of relaxation of the contraction ring in the antrum. However, it is noted that the location of the contraction is not the same in each tracing, and this may be due to a peristaltic action which cannot be studied in a small number of films made at rather wide intervals. Figure 8 shows that the stomach is somewhat shortened at the peak of the wave and the fundus is moderately dilated rather than contracted as suggested by Carlson.

Although the method used is too crude for the study of the rapid transition of the stomach from one shape to another, we are fairly certain that hunger pain occurs simultaneously with a contraction of the lower segment of the stomach which completely obliterates the lumen for a few seconds at a time. It hardly seems reasonable to assume that hyperperistalsis causes hunger pain since roentgenologists have often seen extreme hyperperistalsis of the stomach not accompanied by pain. It is interesting to note, however, that spastic contractions of the antrum of the stomach are often observed during the barium meal examination. Such contractions may be due to extragastric pathology, and it is our impression that they are not always accompanied by epigastric pain. It seems likely that such tonic conditions may correspond to the stage of increased tonus just described rather than to the recurring hunger contractions which are more vigorous and produce pain.

Painful contractions of the stomach do not occur when it contains an appreciable amount of food. The assumption that the hunger pain which appears so frequently with peptic ulcer may be due to contractions of the gastric antrum does not seem poorly founded. In fact, Ginsburg, Tumpowsky and Hamburger[5] have demonstrated by the balloon method that the recurrent, gnawing, epigastric pain in a case of gastric ulcer was synchronous with the recorded contractions. We hope at some future date to obtain roentgenograms of an inflated balloon in the stomach of a patient with duodenal ulcer during hunger, but as yet the opportunity has not been offered us for this experiment.

SUMMARY

A method is described whereby the gastric motility characteristic of hunger may be examined roentgenographically.

The primary or essential element in the painful hunger contraction appears to be a complete circular constriction in the lower third of the stomach. Contractions of the upper stomach may or may not occur simultaneously with this antral contraction.

During the period of incomplete gastric

tetanus which may occur during hunger, several changes were observed including circular contractions of the antrum, a general shortening of the stomach and a wave distribution suggesting peristaltic activity at times.

Rhythmic changes in the fundus described by certain physiologists as the cause of the tonus changes were not observed. These tonus variations appear to be due to the presence of partially relaxed contraction waves situated for the most part in the lower portion of the stomach.

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DISTRIBUTION OF RADIATION ABOUT THE TARGET OF A ROENTGEN-RAY TUBE*

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A KNOWLEDGE of the distribution of radiation about the target of a roentgen-ray tube is of importance in determining the care with which the target of a roentgen tube must be adjusted in radiation therapy.

The variation of the roentgen-ray intensity around the girdle of the high voltage roentgen tube has been investigated by Coolidge and is shown in Figure 1.[1] These intensity measurements were made with an ionization chamber excluding all scattered and characteristic radiation.

We have been interested in comparing the measurements of radiation around the girdle of the roentgen tube in air with those made with the ionization chamber submerged in water. We have made our measurements of radiation intensity with a horn ionization chamber having a graphite electrode and a capacity of about one cubic centimeter. The electrode in the horn ionization chamber was attached through a flexible cable to an electroscope as shown in Figure 2.

Radiation was produced by operating the roentgen-ray machine to excite an air-cooled roentgen tube as follows: 200 kv., 4 ma., 0.5 mm. Cu plus 2 mm. Al as filters, 50 cm. skin target distance and a square field 16 cm. on each side.

The ionization chamber was placed in the center of the field of radiation at 50 cm. distance from the target. The roentgen tube was then rotated about its axis and measurements of radiation intensity made for every 5 or 10 degrees change.

Intensity measurements were made with the ionization chamber in air, half-submerged, 5 and 10 cm. in water. The surface of the water was kept at 50 cm. distance from the target. When measurements of radiation intensity were made at 5 and 10 cm. in water, the ionization chamber was at a distance of 55 and 60 cm. respectively from the target.

* Read at the Twenty-seventh Annual Meeting, American Roentgen Ray Society, Detroit, Mich., May 17–21, 1926.

Figure 3 shows the method of measuring the rotation of the roentgen tube. A cardboard with a circular scale in degrees is placed inside the tube holder. A 2-inch glass tube is attached to the stem of the roentgen tube by friction tape. In taking readings of the position of the target in

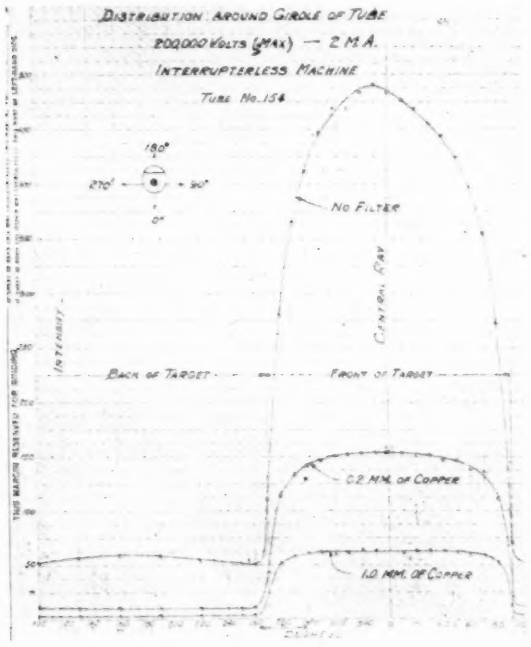

FIG. 1.

reference to the cardboard scale, the blunt end of a glass pointer is inserted into the 2-inch glass tube fastened to the stem of the roentgen tube, while the pointed end of the glass tube touches the scale indicating the position in degrees.

Table 1 gives the number of degrees that the target of the roentgen tube can be rotated and still give approximately constant intensity. Also the corresponding arc length is given in centimeters.

TABLE 1

Position of the Ionization Chamber	Distance from Target, Cm.	Degrees for Approximately Equal Intensity	Arc Length in Centimeters
In air	50	115	104 cm.—50 cm. from target
Half-submerged in water	50	110	96 cm.—50 cm. from target
5 cm. in water	55	126	114 cm.—55 cm. from target
10 cm. in water	60	147	152 cm.—60 cm. from target

Figure 4 shows the relation of radiation intensity to the position of the target in degrees. It is seen that when the ionization chamber is placed 5 and 10 cm. in water the angle through which there is approxi-

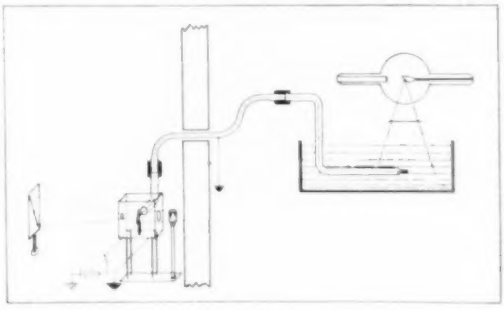

FIG. 2.

mately equal intensity is increased. This increase is due: first, to the projection of scattered radiation beyond the cone of the primary beam; and second, to the fact that as the ionization chamber is lowered in the water, the percentage of the total radi-

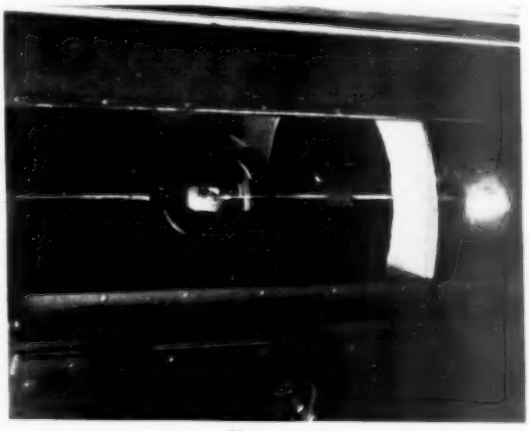

FIG. 3.

ation intensity caused by scattered radiation increases very much.

Measurements of intensity from various angles of the target were also made with an aluminum ionization chamber[2] where the entire cone of radiation as it emerges from the copper is measured. The distance of the ionization chamber is 33 cm. and the opening is 15 cm. in diameter. The curve in Figure 5 shows the relation between radi-

ation intensity as measured by the aluminum ionization chamber and degrees change in the position of the target. For a change of 70 degrees, the intensity remains constant, after which further changes in the position of the target cause a decrease in intensity. The arc of the circle at 33 cm.

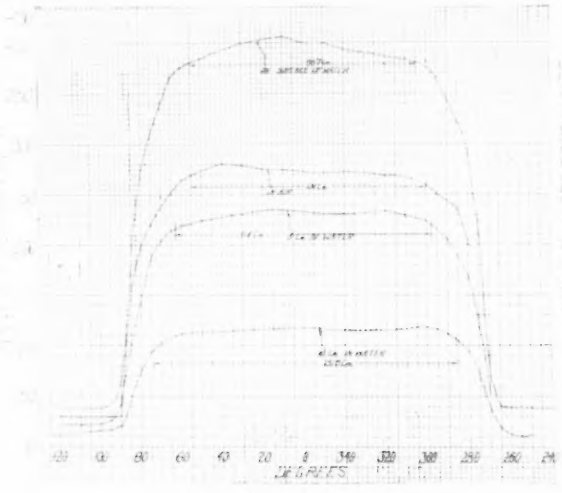

FIG. 4.

from the target is about 40.5 cm. and the arc of the circle 50 cm. from the target is 61 cm. The 70° can be extended to 125° with not more than 10 per cent decrease in intensity.

The question has been asked as to the possibility of treating two patients at once from the same roentgen tube. If two ports of entry are arranged so that the cones of radiation are in the angle of equal intensity, as shown by Figures 4 and 5, we think it is possible.

If one port of entry is used, equal intensity will be maintained over the entire field if the face of the target is approximately perpendicular to the direction of radiation.

We expect to compare the above measurements of the distribution of radiation about the girdle of an air-cooled roentgen tube to the distribution of radiation about a water-cooled roentgen tube.

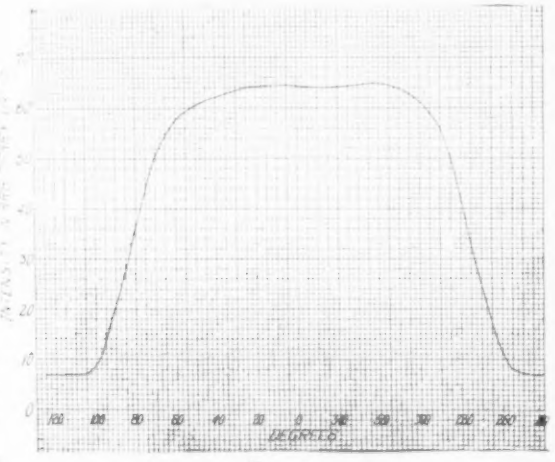

FIG. 5.

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ROENTGEN-RAY DOSES REQUIRED TO PRODUCE CLINICAL ERYTHEMA

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THERE seems to be little uniformity and much confusion at present among radiologists in this country as to the erythema dose on which their roentgenologic treatment is based. Even among those using the same type of machine for the excitation of the same model of Coolidge tube there is slight agreement on the time of erythema production. Indeed, some commercial firms make much of the advertising claim that their apparatus is the most effective in the time required to produce a dose. Those roentgenologists who are fortunate enough to have an ionization system, or other form of dosimeter, by which to check their clinical dose, do not agree with others using a different system of measurement. Ordinarily, their erythema time varies within quite wide limits. Those who have no iontoquantimetric check, but depend on the "indirect methods" of estimating roentgen intensity, are seemingly no worse off than those who use the various ionization chambers, the readings of one of which are difficult to translate into values of another.

If one accepts biologic standards of dosimetry, such as the H.E.D., or U.S.D. (or other similarly based on redness of the skin), one is apparently no better off, for abundant clinical and biologic studies have shown that these clinico-biologic units, even though based on absolute physical standards, have no fixed value. Recent work by Grebe and Martius[1] and by Kaplan[2] has well demonstrated the variation in the H.E.D. among various European clinics using theoretically the same unit of dosimetry. The confusion of dosage expressed in the German and French R unit is too well known to be more than mentioned. Indeed, the multiplicity of units, and the variation of each individual unit of measurement, is so well recognized that a standard is to be set by an international committee, the need of which has been emphasized in a recent paper by Béclère.[3]

Unfortunately, from a clinical point of view, patients to be treated for cancer cannot be standardized, and units of biologic measurements, based on clinical control, also vary widely. It is questionable whether there is as uniform a response to uniform doses of heavily filtered roentgen rays of short wave length as there is to the radiations used in superficial treatment, but the preponderance of evidence at present contradicts such a view.

In a previous study[4] it was shown that the clinical erythema established with rigorously controlled physical factors was no well defined unit, and little uniformity was found in the reaction to a standard dose, produced by the factors given. It seemed better, therefore, to base clinical dosage on well-defined physical standards, rather than on a loose biologic unit.

This report consists of some erythema values, obtained by a cross-check of two ionization systems, the values obtained being submitted to clinical control. In previous papers[5,6,7] Weatherwax and I described the electrical apparatus by which various intensities of roentgen rays were produced, and gave descriptions of both the electroscope and galvanometer types of iontoquantimeters which we used.

In the determination of the time required to produce erythema the galvanometer system was used first, and the calculations made according to the method described by Weatherwax. These figures were then checked against electroscopic measurements of the intensity of the ray, with the ionization chamber half submerged in a water phantom, according to the technique previously described.

It should be mentioned in passing that the intensity of redness of an erythematous area is, according to the best authority obtainable, only a matter of the judgment

of the roentgenologist making the observation. There seem to be in the literature no well-defined threshold values of erythema produced by heavily filtered roentgen rays of short wave length. Accordingly wide differences are possible in the erythema produced by the same biologic and electrical conditions.

The averages of both ionization systems were used for clinical check only up to about 180 minutes, beyond which time clinical experimentation was not considered justifiable, or worth while.

In this group of observations (about 100 altogether) not a sufficient number of cases was investigated to assign limits of erythema production with each value; nor have I investigated thoroughly whether a uniform erythema was produced by the use of any technique for a definite time. However, from previous work[1] it was thought unlikely, as little constancy of erythema production with constant physical factors was observed. Inasmuch as an erythema is here regarded as a first degree burn, without defining its intensity, I have not sought to obtain a uniform redness within the periods given here. However, these values have been shown to be clinically safe, but above threshold value in many cases (Fig. 1).

In the chart the ordinates represent time in minutes, and the abscissae, millimeters of copper or aluminum filter. Curves *a* and *a'* are those obtained with roentgen rays produced at 200 kv. maximum, and curves *b* and *b'* at 168 kv. maximum. The curves of aluminum have been given only to about 5 mm., as beyond that thickness the use of copper filters is more convenient. By calculation and by clinical check it was determined that from 16 to 18 mm. of aluminum is equivalent, with 200 kilovolts, in filtration value (considered from the standpoint of erythema production) to 1 mm. of copper. In those cases in which aluminum is used as a secondary filter for copper, the values established by the curves are to be increased by about 3 per cent. These curves have been of considerable assistance whenever a change of technique requiring modification of routine voltage and filtration was indicated, in that correct time of skin reaction could be read directly from the chart.

Whether these values are peculiar to the system of roentgen-ray production used, or to the clinical condition of the patients studied (50 per cent being more than fifty years old and often in none too good health) has not yet been fully investigated.

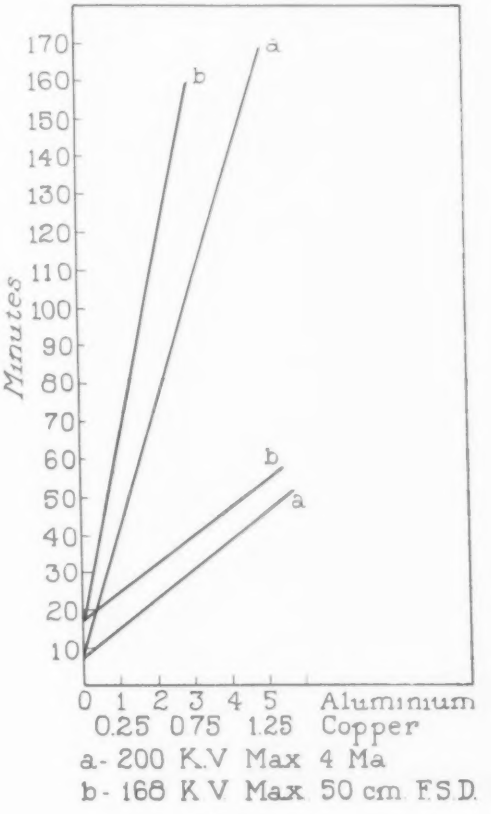

FIG. 1.

SUMMARY

Curves are given of the time required to produce erythema as obtained by two ionization systems and a clinical check. These values should be checked by another dosimeter, and by clinical studies, and might be given in R units if expedient.

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THE RATIONALE OF RADIOTHERAPY IN HODGKIN'S DISEASE AND LYMPHOSARCOMA

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UNDER the term lymphoblastoma are included: lymphogranuloma (Hodgkin's disease; lymphadenoma); lymphosarcoma; leucosarcoma (Sternberg); and leucemia, lymphocytic or myelocytic. The tendency at the present time is to regard these different pathologic disturbances as more or less closely related, but the manner of the relationship will not be definitely known until the etiologic factors involved are better understood.

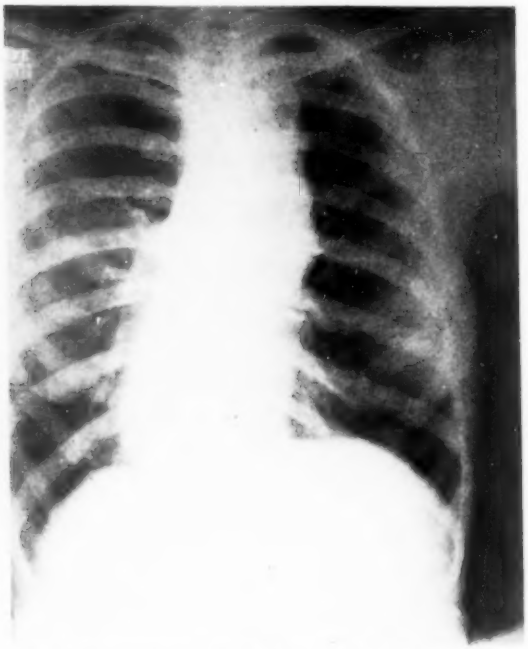

FIG. 1. Roentgenogram of thorax July 29, 1921, showing mediastinal tumor.

These various diseases are characterized by a natural tendency to progress toward a fatal issue in spite of treatment. The rate of progress may vary greatly, some cases being much more acute than others. It has been found that the average duration of Hodgkin's granuloma and lymphosarcoma is two and one-half years. However, in the group of cases from which this average duration was obtained, some ran an acute course and the patients died within a few months from the onset of symptoms, while others lived from ten to fifteen years or even longer.

Thus far, neither medicinal nor surgical measures have been of much avail in the treatment of these cases. As the result of Billroth's report in 1871, of the rather remarkable effect of arsenic in one case, this drug became widely used and found a place in nearly every medical textbook. Most of the writers on the subject agreed that in early cases, when large doses were given over a prolonged period, arsenic did result in transient improvement. However, the results obtained were not altogether satisfactory, and thus drugs are now seldom employed after the diagnosis has been firmly established. Surgical exci-

sion of enlarged lymph nodes has yielded nothing but disappointment, so that today good surgeons content themselves with removing a node for microscopic examination in order to establish the diagnosis definitely.

The only form of treatment which has shown itself to be really useful is radiotherapy. If we may judge by the lack of reports of cured patients, the disease remains as incurable as ever; and yet the outlook of the victim, while ultimately hopeless, is not immediately so desperate. In irradiation we have a means of reliev-

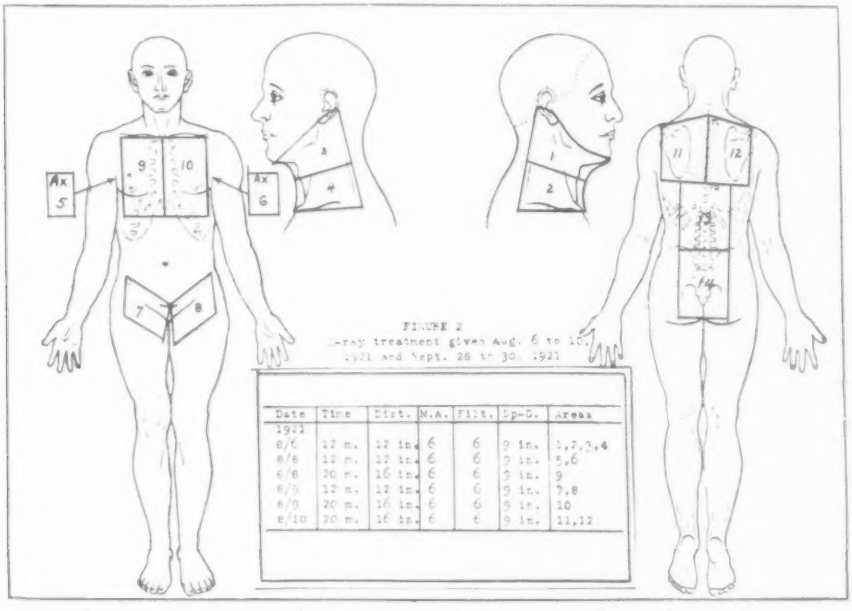

FIG. 2. Roentgen treatment given August 6 to 10, 1921 and September 29 to 30, 1921.

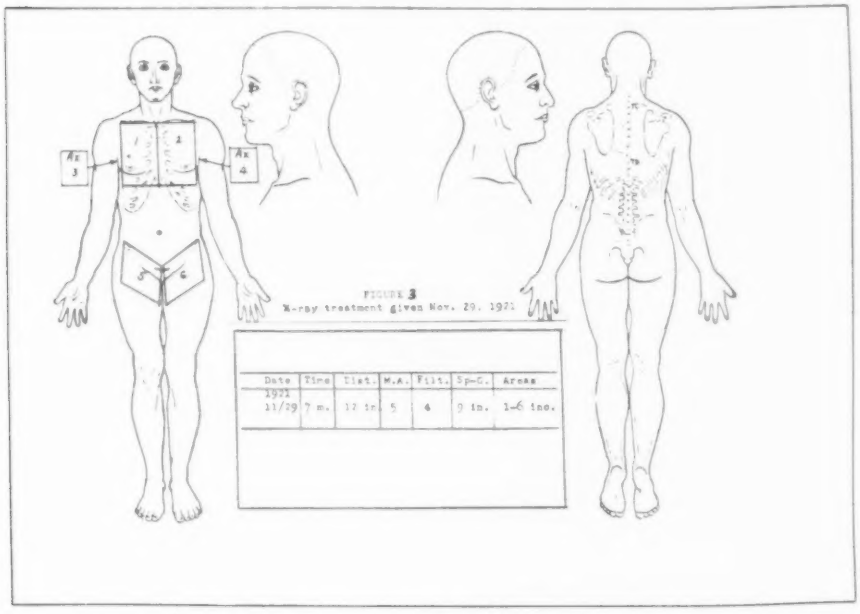

FIG. 3. Roentgen treatment given November 29, 1921.

ing many patients for more or less prolonged periods, the primary results being often little short of miraculous. The response is so striking, indeed, that it constitutes a valuable therapeutic test of Hodgkin's disease and lymphosarcoma when a biopsy cannot be made. The rapid decrease in size of the masses of nodes within from one to three weeks following treatment by roentgen rays or radium is absolutely characteristic. In no other disease (except in the secondary manifestations of malig-

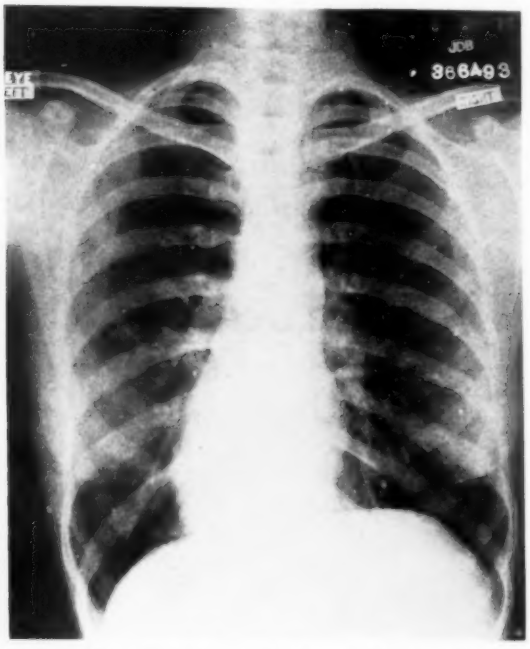

FIG. 4. Roentgenogram of thorax March 28, 1922, showing complete disappearance of mediastinal tumor.

nant testicular embryoma, with which there can be little room for confusion) do enlarged nodes melt away so rapidly under irradiation as they do in this. Moreover, it may well be that, as the result of earlier recognition and of more promptness in instituting treatment, a certain percentage of cases may be prevented from progressing further. Unfortunately, too many patients, when they apply for treatment, have reached such a desperate stage as to cause serious impairment of general health, with direct or indirect obstructive phenomena in the respiratory, digestive or circulatory systems.

TECHNIQUE OF RADIOTHERAPY

The technical application of radiotherapy in cases of lymphosarcoma and Hodgkin's disease is subject to certain general considerations. The lymphoid cells of the spleen and of the lymph nodes, and the circulating lymphocytes are, next to the genital glands, the most highly radiosensitive structures in the body, particularly if the cells are in a state of hyperplasia. Thus, in lymphosarcoma and Hodgkin's disease, the enlarged lymph nodes diminish in size quickly after even small doses of roentgen rays or radium. The radiosensitiveness of the lymphoid elements of lymphosarcoma is slightly greater than in Hodgkin's disease, but in many cases the difference is so slight as to be hardly perceptible. The lymphocytes and lymphoid cells generally, while extremely sensitive to irradiation when first treated, gradually become less and less sensitive after repeated treatment, until finally they fail to respond at all. Whether this is due to the gradual replacement of the lymphoid elements of the spleen and lymph nodes by connective tissue or whether the cells acquire increased power to resist the destructive effect of the rays, has not been finally settled. Clinical and pathologic evidence indicates that both factors play a part in the process.

In Hodgkin's disease, lymphosarcoma and leucosarcoma, radiotherapy may be applied by means of roentgen rays or radium, according to the presence or absence of certain factors. In the majority of cases, in which enlargement of the nodes is not extreme and the symptoms and general disability are not critical, the treatment of choice is by roentgen rays. At the outset the quality of such radiation should be of only moderate penetration. The aim should be to destroy as large a number of lymphocytes and to produce as little fibrosis in the lymph nodes as possible. At first the effect of treatment in the average case is both rapid and profound. The enlarged nodes diminish in size rapidly, and a corresponding improvement occurs in the general condition.

After radiotherapy has been repeated several times the enlarged nodes may no longer be palpable. Indeed large masses of

such nodes, sometimes forming voluminous tumors, frequently disappear completely. Nevertheless, after a certain length of time, fresh evidence of lymphatic hyperplasia becomes apparent. This may be a matter of months or of several years, but gradually the cells acquire an increasing tolerance to the rays, and sooner or later irradiation fails to exert any marked influence on such enlarged nodes as may then be present. If the radiologist "shoots his heaviest bolt" first in the form of high voltage roentgen rays at the outset it may, it is true, yield most gratifying and

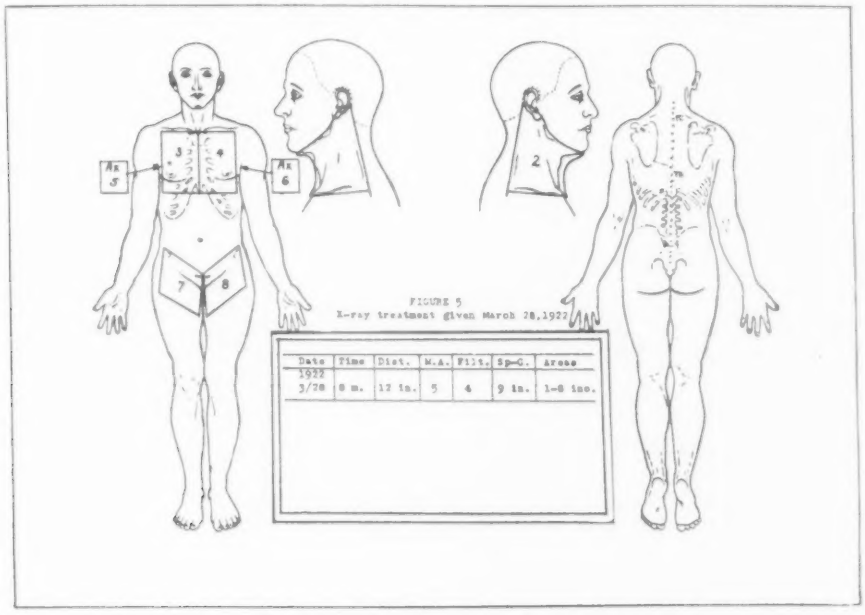

FIG. 5. Roentgen treatment given March 28, 1922.

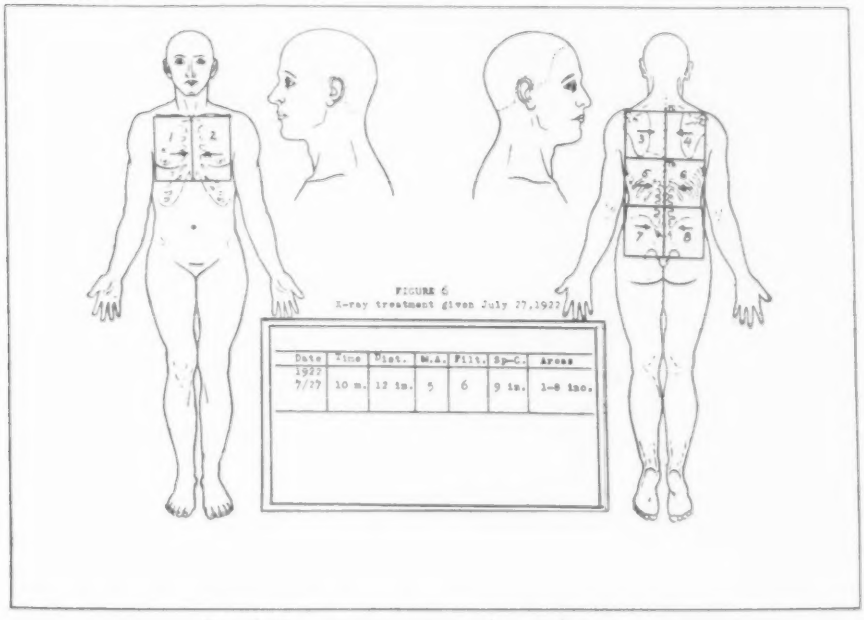

FIG. 6. Roentgen treatment given July 27, 1922.

startling immediate regression, but when, later, recurrence of adenopathy causes the patient to seek further treatment, such treatment will be found much less effective. The same is true of the use of radium for the same reason. Therefore, inasmuch as radiotherapy has been shown not to prevent the fatal outcome of the disease, no matter how treated, it is evidence of good judgment to reserve the heavy artillery until the lighter guns have exhausted their effect.

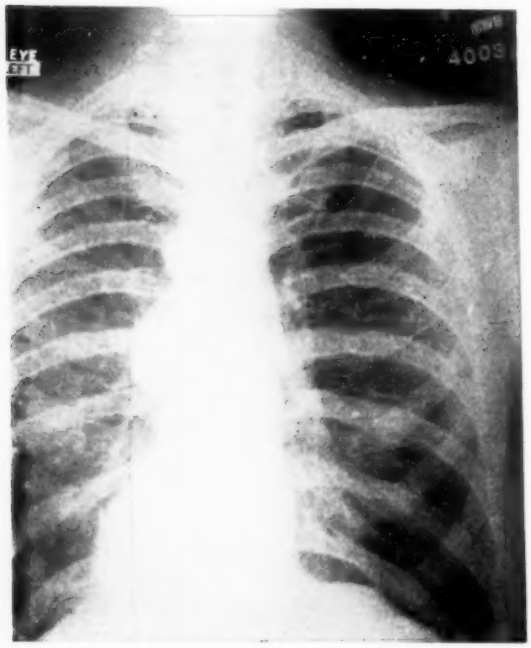

FIG. 7. Roentgenogram of thorax August 4, 1922, showing mediastinal tumor on the left side.

At the outset, the treatment should be rather general and should be directed not only to the palpably enlarged nodes or masses of nodes, but also to the mediastinal and lower paravertebral lymphatic chains, even though definite evidence of disease in these regions should be absent. In view of the nature of these conditions, it may be generally assumed that the disease is much more general than may be indicated by the actually perceptible adenopathy.

As a rule treatment must be repeated from one to several times before the adenopathy subsides entirely. However, in certain cases lymphatic enlargement never completely disappears. In any event, when the treatment has produced its maximal effect, it should be discontinued, but the patient should be kept under periodic observation. Such observation should consist of a careful and complete search for evidence of fresh activity in the form of glandular enlargement and should include

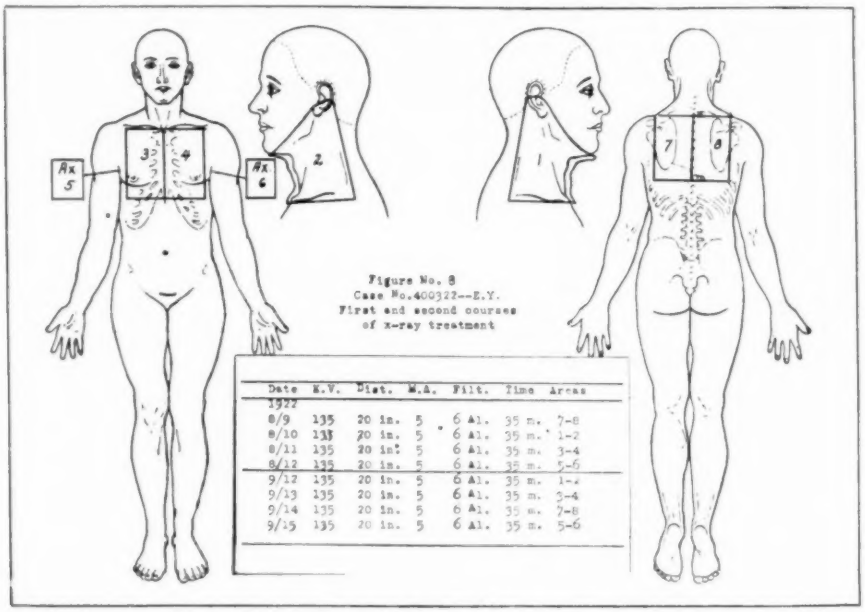

FIG. 8. First and second courses of roentgen treatment.

a roentgenologic study of the mediastinum and lungs, as well as a differential blood count. It is not safe to allow the patient to omit such periodic examination, or merely to instruct him to consult his physician if, or when, symptoms recur. Since pain is not an important feature of the disease, and since many patients consider themselves well so long as they remain free from pain, they and the attending physician must be strongly impressed with the necessity of regular examination.

Since the means became available of generating roentgen rays at very high voltage, many radiologists have attempted a much too general use of such short wavelength rays. Such a procedure may be desirable in a few cases in dealing with certain manifestations of the disease, but in most cases roentgen rays generated at moderate voltage are distinctly preferable, at least at the outset. Consequently, it is usually better to inaugurate treatment with roentgen rays generated at moderate voltage (135 to 140 peak kilovolts) than with high voltage roentgen rays (200 peak kilovolts) or radium. However, with respect to high voltage roentgen rays and radium certain reservations may obtain in a few cases. The radiologist is sometimes consulted about radiotherapy by, or on behalf of, a patient in whom the adenopathy may have attained such proportions as to cause pronounced symptoms of respiratory or circulatory obstruction or

Fig. 9. Roentgenogram of thorax November 7, 1922, showing disappearance of the mediastinal tumor.

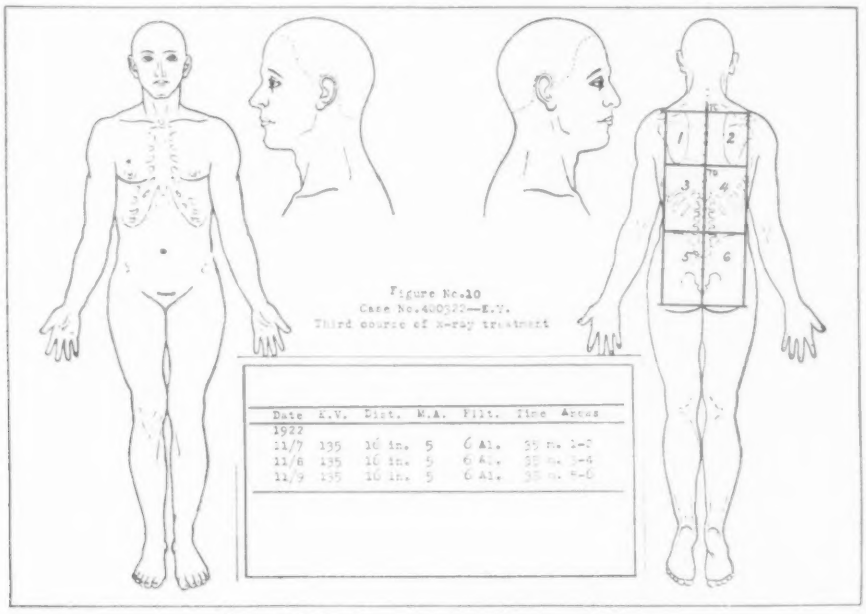
Figure No.10
Case No.480922—E.V.
Third course of X-ray treatment
Date K.V. Dist. M.A. Filt. Time Areas
1922
11/7 135 10 in. 5 6 Al. 35 m. 1-2
11/8 135 10 in. 5 6 Al. 35 m. 3-4
11/9 135 10 in. 5 6 Al. 35 m. 5-6

Fig. 10. Third course of roentgen treatment.

other evidence of pressure and the condition is emergent. This is more common when the involvement is in the cervical or mediastinal glands rather than in other regions. In such cases quick action is imperative, and high voltage roentgen rays, or radium in the form of a large pack, may be very effective and may relieve a desperate situation in less time than roentgen rays generated at lower voltage. Still, one must be cautious; the regression so obtained, however gratifying at the time, may not be in the best interests of the patient. In my own experience two patients so treated with radium died soon afterward, and I feel certain that the treatment was largely responsible for the death of one of them. Generally roentgen rays of moderate penetration are most effective, even though the glandular enlargement and the consequent symptoms are pronounced.

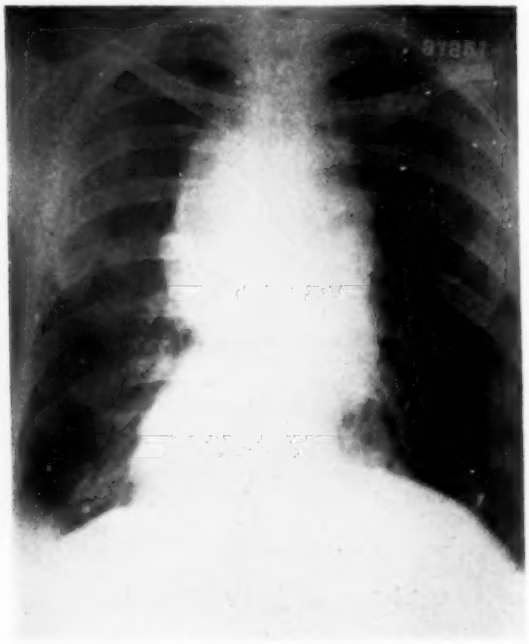

FIG. 11. Roentgenogram of thorax November 30, 1921, showing very large mediastinal tumor before treatment.

As examples of the therapeutic effect of irradiation in Hodgkin's disease and lymphosarcoma 4 cases are cited which will serve to illustrate what may be expected from such treatment in the various stages of these diseases.

CASE 1. A woman, aged twenty-seven, registered at the Mayo Clinic July 28, 1921, complaining of enlargement of the nodes in the right side of the neck. About one and one-half years previously, following the extraction of an upper molar tooth, the patient had noticed an enlarged node, quite painless, at the root of the neck on the right side. This had remained stationary. Since the birth of her last child, two years before she came to the Clinic, she had not felt quite as strong as before. In the spring of 1921 she had contracted a severe cold, with cough and expectoration of mucopurulent material; this had lasted one month, and during this period the enlarged node at the right side of the neck had increased in size. Her tonsils had been removed three years previously because of frequent attacks of tonsillitis. Her teeth had long been in bad condition and had given her considerable trouble. Since the spring of 1921 she had been much distressed by itching all over her body, which had begun in the hands and feet.

On examination slightly enlarged, discrete lymph nodes were found in both anterior cervical triangles. At the base of the right posterior cervical triangle there was a much larger node, soft and slightly tender, measuring about 4 by 2 cm. There was also a broad area of dullness at the level of the upper end of the sternum, especially on the right side (Fig. 1). Roentgenologic examination of the thorax disclosed mediastinal tumefaction extending from the level of the first to that of the fourth rib anteriorly. The hemoglobin was 50 per cent, the erythrocytes numbered 3,620,000, leucocytes 5,400 with 63.5 per cent polymorphonuclear cells, 20.5 per cent lymphocytes and 8.5 per cent eosinophils. A node removed from the right supraclavicular space on August 2 was examined microscopically and showed the characteristics of Hodgkin's disease.

A course of roentgen-ray treatment was given between August 6 and 10, the details of which are shown in Figure 2. The patient was instructed to return September 28, and on this date she was distinctly better. The general pruritus had ceased; she was sleeping quite well and was free from cough. She weighed 112 pounds, a gain of 5 pounds. A few very slightly enlarged nodes could be felt in the right supraclavicular space. The size of the mediastinal tumor had also diminished.

A second course of treatment, similar in every respect to the first course, was given between September 28 and 30. When she returned November 29 she reported having moderate systemic reaction following the previous course of treatment and shortly afterward

of having contracted a severe cold, with cough which lasted three weeks; this had almost completely subsided. Her appetite had not yet

ray treatment was given with the idea of continuing the radiation effect without producing any systemic reaction and giving the patient an

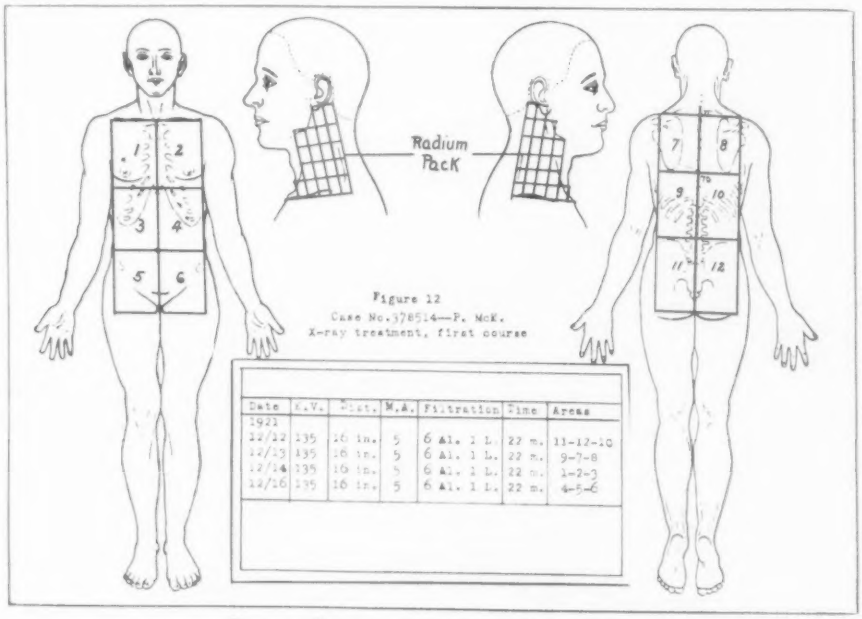
Radium Pack
1
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Figure 12
Case No.378514—P. McK.
X-ray treatment, first course
Date | K.V. | Dist. | M.A. | Filtration | Time | Areas
1921
12/12 | 135 | 16 in. | 5 | 6 Al. 1 L. | 22 m. | 11-12-10
12/13 | 135 | 16 in. | 5 | 6 Al. 1 L. | 22 m. | 9-7-8
12/14 | 135 | 16 in. | 5 | 6 Al. 1 L. | 22 m. | 1-2-3
12/16 | 135 | 16 in. | 5 | 6 Al. 1 L. | 22 m. | 4-5-6

FIG. 12. Roentgen treatment, first course.

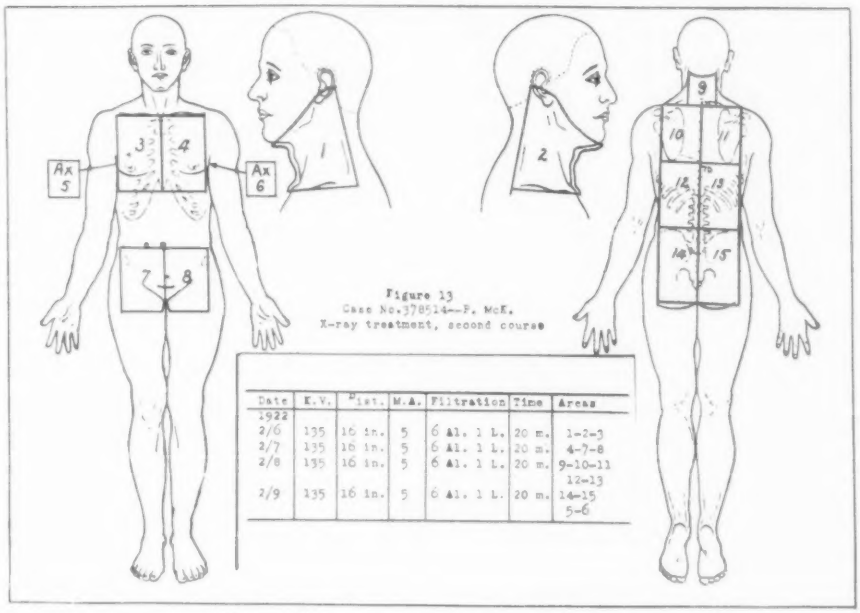

FIG. 13. Roentgen treatment, second course.

recovered from the systemic reaction following the previous course of treatment and she had lost 1 or 2 pounds. Roentgenologic examination was negative, the mediastinal tumor having totally disappeared. A light course of roentgen-

opportunity to recover more fully from the previous course (Fig. 3). The patient was not seen again until March 28, 1922, when she said that she felt as well as she ever had. Her weight was 104.5 pounds. The only evidence of

adenopathy discoverable consisted of slightly enlarged right axillary nodes. It should be

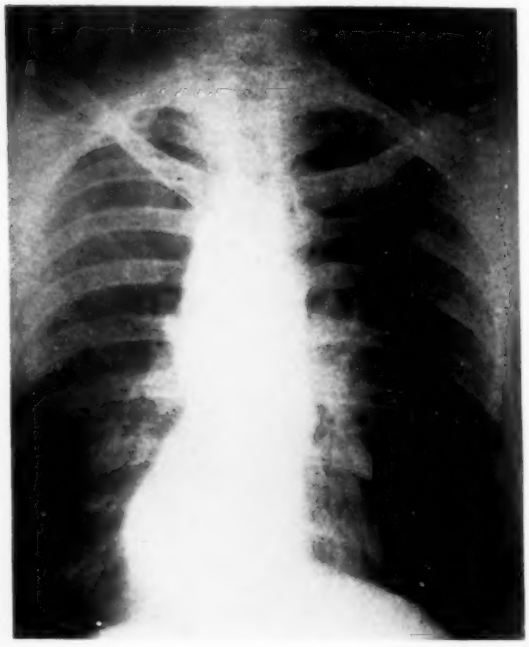

FIG. 14. Roentgenogram of thorax April 12, 1922, showing marked reduction in the mediastinal tumefaction.

that induced by the previous radiotherapy (Fig. 4). Roentgenologic examination of the thorax on the same date was negative. Roentgen-ray treatment was again given, and again the treatment was light in dosage and limited in distribution as compared with the first two courses (Fig. 5).

On July 26 the patient reported that she had been perfectly well until one month previously when a papular eruption had appeared over the anterior thorax, accompanied by itching. This had subsided somewhat. Later a similar eruption appeared on the legs and arms, also accompanied by itching. This was still present but was not so severe. She had not menstruated since December, 1921, but was free from symptoms generally accompanying cessation of ovarian function. Her weight was 106 pounds. The only evidence of adenopathy was represented by slightly enlarged nodes in both axillae. Roentgenologic examination was negative. The skin eruption and pruritus were regarded as toxic in character and due to lymphomatous activity somewhere in the body. Consequently another course of roentgen-ray treatment was given, but this was limited to the trunk (Fig. 6).

The patient did not return to the clinic until December 21, 1924. She reported having been remarkably well since her previous visit in

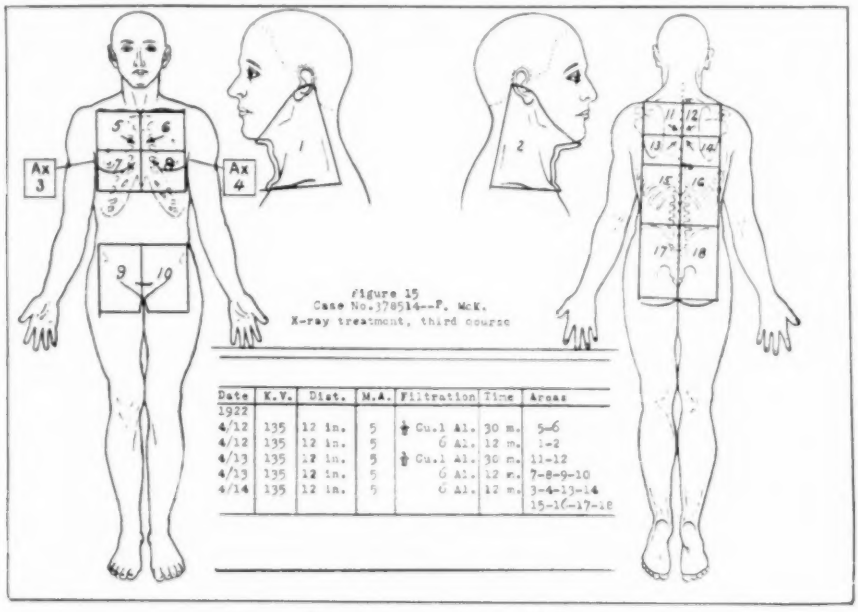
Ax 3
Ax 4
Figure 15
Case No.378514--F. McK.
X-ray treatment, third course
Date | K.V. | Dist. | M.A. | Filtration | Time | Areas
1922
4/12 | 135 | 12 in. | 5 | ½ Cu.1 Al. | 30 m. | 5-6
4/12 | 135 | 12 in. | 5 | 6 Al. | 12 m. | 1-2
4/13 | 135 | 12 in. | 5 | ½ Cu.1 Al. | 30 m. | 11-12
4/13 | 135 | 12 in. | 5 | 6 Al. | 12 m. | 7-8-9-10
4/14 | 135 | 12 in. | 5 | 6 Al. | 12 m. | 3-4-13-14
15-16-17-18

FIG. 15. Roentgen treatment, third course.

mentioned that the patient had not menstruated for three months, probably because of the weakness due to the disease itself and to July, 1922. Menstruation had reappeared a short time before. She was entirely free from adenopathy and the mediastinum was normal.

December 2, 1924, the hemoglobin was 66 per cent, the erythrocytes numbered 4,470,000 and the leucocytes 6,200. The patient is still living and in good health.

no other symptoms indicative of serious damage to the ovaries. None of the other usual manifestations of amenorrhea supervened, and the menstrual function re-

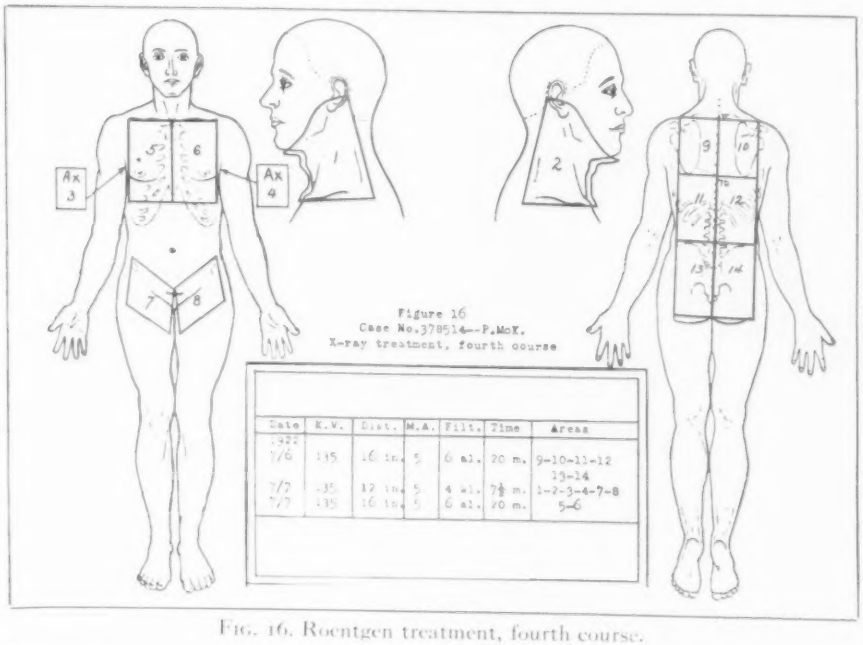

Figure 16
Case No.378514—P.McK.
X-ray treatment, fourth course

Date	K.V.	Dist.	M.A.	Filt.	Time	Areas
1925						
7/6	135	16 in.	5	6 al.	20 m.	9-10-11-12 13-14
7/7	135	12 in.	5	4 al.	7½ m.	1-2-3-4-7-8
7/7	135	16 in.	5	6 al.	20 m.	5-6

Fig. 16. Roentgen treatment, fourth course.

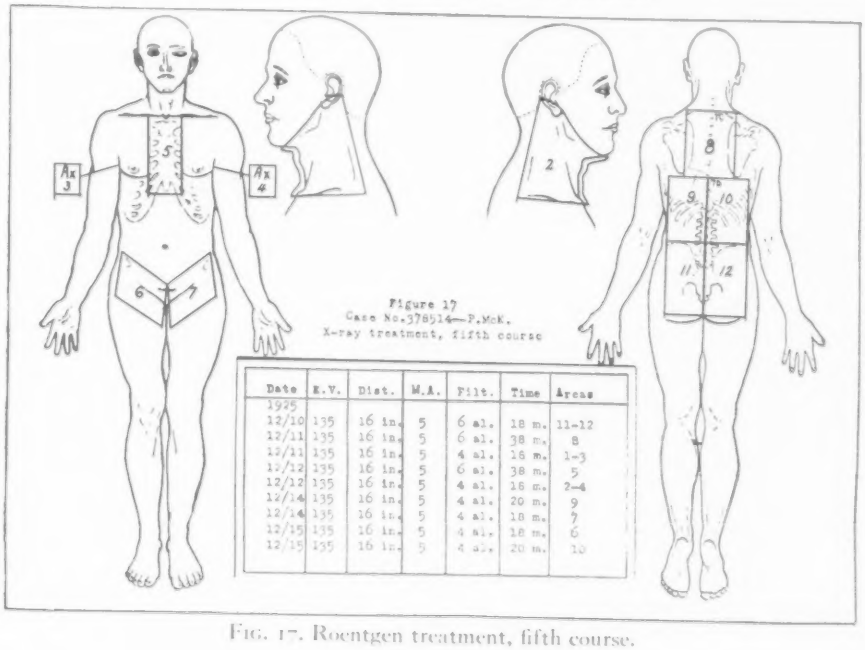

Figure 17
Case No.378514—P.McK.
X-ray treatment, fifth course

Date	K.V.	Dist.	M.A.	Filt.	Time	Areas
1925						
12/10	135	16 in.	5	6 al.	18 m.	11-12
12/11	135	16 in.	5	6 al.	38 m.	8
12/11	135	16 in.	5	4 al.	16 m.	1-3
12/12	135	16 in.	5	6 al.	38 m.	5
12/12	135	16 in.	5	4 al.	16 m.	2-4
12/14	135	16 in.	5	4 al.	20 m.	9
12/14	135	16 in.	5	4 al.	18 m.	7
12/15	135	16 in.	5	4 al.	18 m.	6
12/15	135	16 in.	5	4 al.	20 m.	10

Fig. 17. Roentgen treatment, fifth course.

Comment. The cessation of menstruation was thought to be due to the roentgen-ray treatment, some of which had been directed to the pelvis, but there were

turned later. Nevertheless, since roentgen rays had been directed to the pelvic structures several times, it is probable that it had much to do with the temporary failure

to menstruate, but that the effect of the rays on the ovaries had not been sufficient to bring about a permanent amenorrhea. However, in order to avoid such a complication which, if permanent, only serves to increase the physical distress of the patient, it is wise, in women of childbearing age, to avoid exposing the pelvis, except when urgent symptoms of pelvic invasion demand relief. If enlarged inguinal nodes require treatment, the rays should be so directed as to avoid the pelvic structures as much as possible.

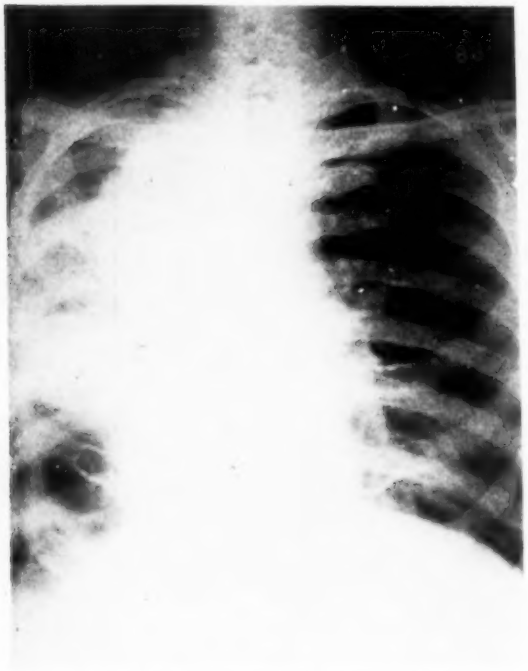

FIG. 18. Very large mediastinal tumor chiefly on the left side with infiltration between the upper and lower lobes of the left lung.

CASE 11. A man, aged fifty-six, registered at the Mayo Clinic August 3, 1922. About April of that year he had first become aware of a tight sensation beneath the sternum, and of dyspnea on exertion. The sensation of tightness had continued unchanged, but the dyspnea had become progressively more severe. However, it was not sufficient to disturb his sleep. Every morning about ten o'clock he had a violent fit of coughing, lasting from five to sixty minutes. After about 1 to 2 teaspoonfuls of greenish-colored sputum had been coughed up the coughing subsided. Gradually this cough had become chronic, although less violent. He had never noticed blood in the sputum. He had lost about 20 pounds during the previous eight months, and his strength had slowly but steadily diminished. He stated further that he thought the so-called attacks of dyspnea, with cough and expectoration, were connected in some way with the presence of dogs, horses or chickens. He had been in the habit of carrying adrenalin and asthma powders.

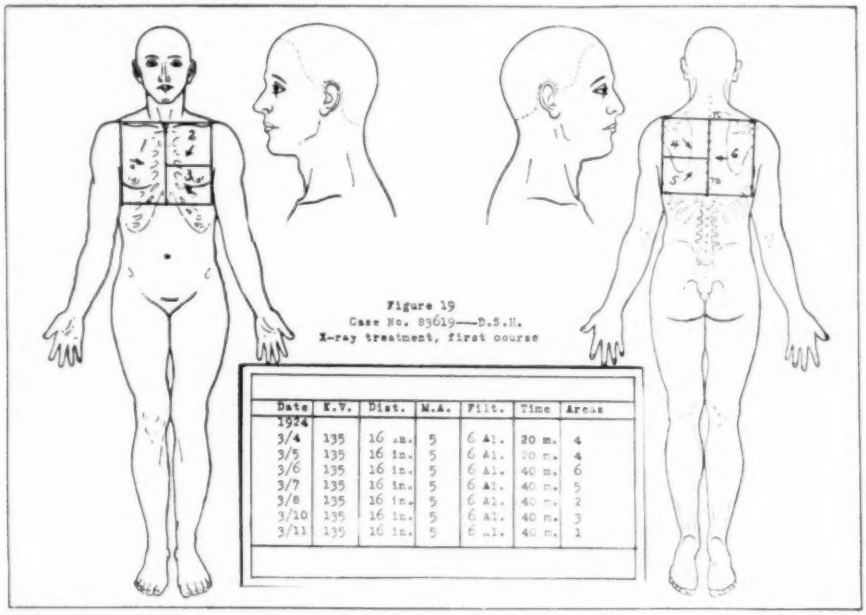
Figure 19
Case No. 83619—D.S.H.
X-ray treatment, first course
Date | K.V. | Dist. | M.A. | Filt. | Time | Areas
1924
3/4 | 135 | 16 in. | 5 | 6 Al. | 20 m. | 4
3/5 | 135 | 16 in. | 5 | 6 Al. | 20 m. | 4
3/6 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 6
3/7 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 5
3/8 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 2
3/10 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 3
3/11 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 1

FIG. 19. Roentgen treatment, first course.

On examination the patient's face was cyanotic and congested; the chest was emphysematous in type, and many whistling and sonorous rattles were audible over both lungs; these did not disappear after coughing. There was slight widening of the upper cardiac dullness. Roentgenologic examination of the thorax revealed a small, round, nonpulsatile tumefaction in the mediastinum projecting toward the left side and extending from the second to the third interspaces (Fig. 7). There was no palpable enlargement of the lymph nodes. A clinical diagnosis of mediastinal tumor, probably lymphosarcoma, was made.

The first course of roentgen-ray treatment was given from August 9 to 12 (Fig. 8). The patient's condition was much improved within a week after the completion of the course. Slight dyspnea was still present. He had lost no further weight. Roentgenologic examination of the thorax September 12 showed diminution in the size of the mediastinal tumor.

A second similar course of roentgen treatment was given from September 12 to 15. On November 7 the patient's respiration had become asthmatic in character, coming in paroxysms, lasting from two to three minutes, two or three times a day. Recently, however, he had begun to feel better. Examination disclosed evidences of bilateral bronchitis. Roentgenologic examination of the thorax was negative (Fig. 9). A third course of treatment was given from November 7 to 9 (Fig. 10).

Comment. The patient has been entirely well since that time and, in spite of strenuous work as an active attorney, his condition has not required further treatment.

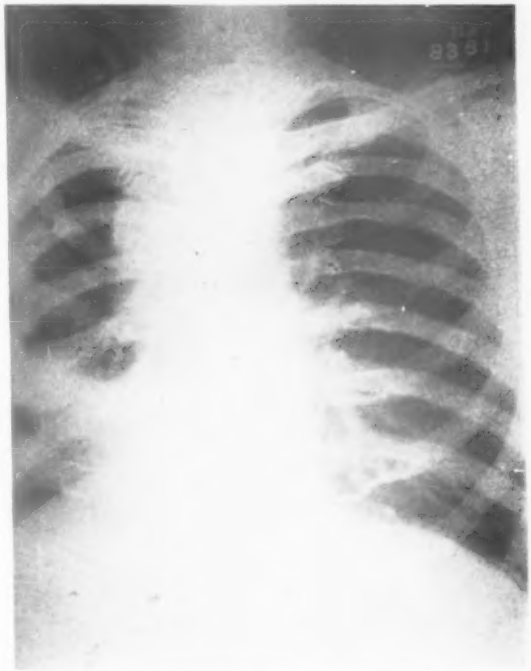

FIG. 20. Roentgenogram of thorax April 1, 1924, showing reduction in the mediastinal tumor and in the interlobar infiltration.

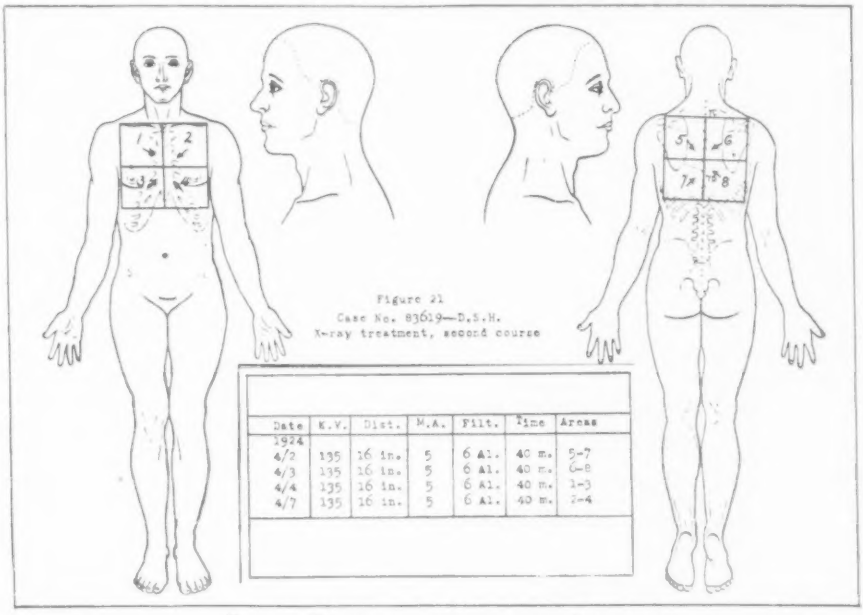
Figure 21
Case No. 83619—D.S.H.
X-ray treatment, second course
Date | K.V. | Dist. | M.A. | Filt. | Time | Areas
1924
4/2 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 5-7
4/3 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 6-8
4/4 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 1-3
4/7 | 135 | 16 in. | 5 | 6 Al. | 40 m. | 2-4

FIG. 21. Roentgen treatment, second course.

CASE III. A man, aged forty-seven, registered at the Mayo Clinic November 29, 1921,

FIG. 22. Roentgenogram of thorax May 14, 1924, showing almost complete disappearance of the mediastinal tumor and left interlobar infiltration, the only trace of which is an annular shadow.

The enlargement had begun about one year previously as a nodular swelling in the left supraclavicular space. Two or three weeks later the patient had become aware of similar swelling in the left submaxillary region. The swelling had gradually increased in size although not at a uniform rate. Ten months previously he had had his teeth extracted without improvement. A node removed from the right supraclavicular space two weeks earlier and examined microscopically had been reported as malignant. His general condition was still fairly good.

On examination fairly marked enlargement was noted of all the nodes on both sides of the neck, in the anterior as well as posterior cervical chains. The right axillary and the right inguinal lymph nodes were also slightly enlarged. A small scar was present in the right supraclavicular space where a node had previously been excised. There was marked broadening of the mediastinal dullness extending about 7.5 cm. from the median line on both sides. The breath sounds were distinctly harsh, especially over the right base. Roentgenologic examination of the thorax showed a large symmetric mediastinal tumor (Fig. 11). A section of the right supraclavicular node previously excised was reëxamined by the pathologist, who now reported lymphosarcoma.

The first course of radiotherapy consisted of combined radium and roentgen rays, the

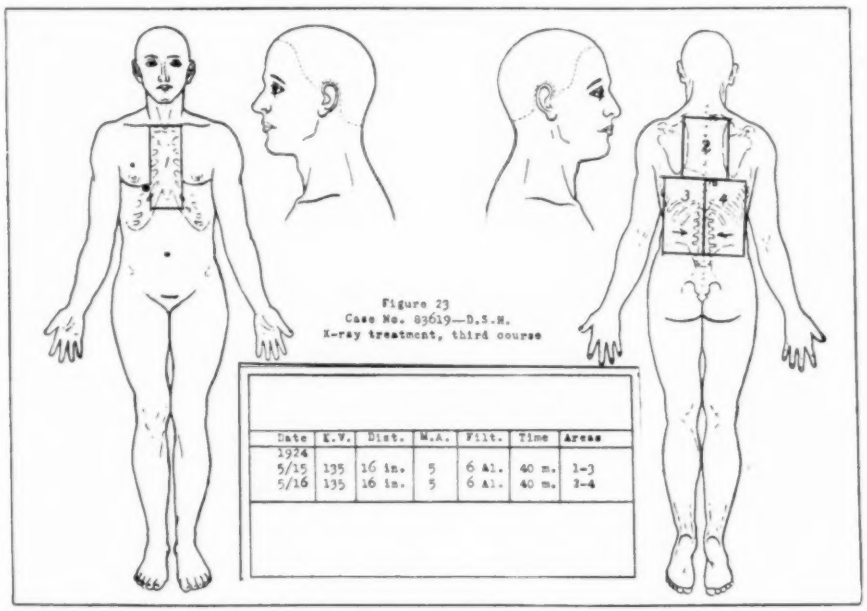
Figure 23
Case No. 83619—D.S.H.
X-ray treatment, third course
Date K.V. Dist. M.A. Filt. Time Areas
1924
5/15 135 16 in. 5 6 Al. 40 m. 1-3
5/16 135 16 in. 5 6 Al. 40 m. 2-4

FIG. 23. Roentgen treatment, third course.

complaining chiefly of enlarged nodes on both sides of the neck and also in the right axilla. former being directed to the right and left cervical and right axillary regions, and the

latter to the mediastinal tumor as well as to the prevertebral (retroperitoneal) lymphatics. There was no real indication for radium in this case, but it was used to test its effectiveness as compared with roentgen rays. The radium treatment was given by means of a large pack covering each side of the neck and the right axilla at one sitting. The radium units were placed 2.5 cm. from the skin with filtration of 0.5 mm. lead and 2 mm. of rubber. The radium dosage in these three regions totaled 11,106 mg-hr. Details of the roentgen-ray treatment, which was given from December 12 to 16, are shown in Figure 12. By February 6, 1922, enlargement of lymph nodes in all regions had diminished 90 per cent. Roentgenologic examination of the thorax showed substantial reduction in the size of the mediastinal tumor.

A second course of roentgen-ray treatment was given (no radium this time) from February 6 to 9 (Fig. 13). On April 12 the patient's general condition was very good. He no longer had any difficulty in breathing, had been working regularly on his farm, and felt able to carry on all his ordinary duties. He was no longer aware of lymphatic enlargement. On examination one slightly enlarged node was found in the left supraclavicular region measuring 1 cm. in diameter. Roentgenologic examination of the thorax showed great reduction in the size of the mediastinal tumor (Fig. 14).

A third course of roentgen-ray treatment was given from April 12 to 14 (Fig. 15). On July 6 the patient reported having had, in the interim, an attack of pulmonary inflammation which had been diagnosed influenza, but this had entirely subsided and he was feeling as well as before, and was working regularly every day. Examination disclosed the same slightly enlarged left supraclavicular node, but nothing more. Roentgenologic examination of the thorax showed slight enlargement of the mediastinal structure.

A fourth course of roentgen-ray treatment was given from July 6 to [illegible] (Fig. 16). The patient was not seen again until December 10, 1925. He had had roentgen-ray treatment elsewhere during the interval about once every four to six months. I was unable to obtain the details. Since June, 1925 he had been troubled with cough, dyspnea, dizziness on exertion and itching below the knees. A roentgenologic examination of the thorax, made elsewhere, had disclosed further evidence of mediastinal enlargement, but this had been kept partly under control by roentgen-ray treatment. Some of this roentgen-ray treatment had been at high voltage.

On examination there was evidence of pulmonary infiltration which was thought to be fibrous. Roentgenologic examination of the thorax showed mediastinal thickening and a condition in the lungs resembling fibrous infiltration.

Roentgen-ray treatment was again given from December 10 to 12, but this was limited as much as possible to the mediastinum, so far as the thorax was concerned. However, treatment was also directed to both sides of the neck, both axillae, both groins and also to the prevertebral (retroperitoneal) lymph nodes (Fig. 17).

Comment. The patient still shows evidence of active disease, which is progressing slowly. Too intensive treatment with high voltage roentgen rays by a radiologist of limited experience may have had something to do with the chronic pulmonary changes now present. Moreover, such changes now render further radiotherapy to the mediastinal structures fraught with considerable risk.

Case IV. A man, aged forty-nine, registered at the Mayo Clinic February 26, 1924, complaining of nervousness and general debility. On December 25, 1923, he had had a severe cold with much hard coughing and expectoration of blood. His attending physician thought he had bronchopneumonia. There was diffuse pain throughout the chest, which seemed worse beneath the sternum. He was in bed for a week with a varying temperature up to 100° F. Although the cough continued, he improved gradually and was able to return to work. Two weeks before coming to the Clinic he had had a chill and again expectorated blood. At the same time he had had severe pain in the left side of the thorax and was forced to take morphin for relief. Since then he had been weak and seemed unable to regain strength. He mentioned having had pneumonia three times during the previous five years. He had lost about 14 pounds in weight during the previous three months.

The patient was well developed, well preserved, and of advanced middle age. He had slight dyspnea and moderate general bronzing of the skin. The important feature of the physical findings was dullness over the entire left half of the thorax, indicating the presence of a large quantity of fluid. The heart was pushed over toward the right. The tendency of the patient to have chills and to sweat suggested empyema, and he was immediately placed in a hospital. A roentgenologic examination of the thorax made the same day revealed a large tumor of the upper mediastinum with an additional separate patch of infiltration between

the two lobes of the lungs on the left side. There was slight pneumothorax at the left base, but no fluid (Fig. 18).

The first course of roentgen-ray treatment was given from March 4 to 11 (Fig. 19). The patient returned to the Clinic April 1, greatly improved in health and strength. Only slight cough persisted. Roentgenologic examination of the thorax showed striking diminution of the mediastinal tumor (Fig. 20).

A second course of roentgen-ray treatment was given from April 2 to 7 (Fig. 21). On May 14 the patient reported that he was feeling quite well. He had been gaining steadily in weight and strength and had been working off and on. He still had a slight cough, but there had been no expectoration of blood for some time. Roentgenologic examination of the thorax showed still further reduction in the size of the mediastinal tumor, and also the infiltration between the lobes of the left lung had entirely disappeared and was now represented only by a thin curved band, giving the impression of the thin wall of a large cavity (Fig. 22).

A third course of treatment was given from May 15 to 16 (Fig. 23). On July 28 the patient returned. He had felt quite well until two weeks previously when he again caught cold and his fever rose to 102° F. He had no pain at that time, but a week later severe pain, which made breathing painful, occurred on the right side of the chest. It began gradually but later required morphin hypodermically for relief, then gradually diminished. Dyspnea had been present and increased for a short time before this acute attack. His general condition was not so good as when he had been examined in May. He was pale and looked like a man in distress. It was decided not to give him further roentgen-ray treatment, but to allow the acute respiratory symptoms to subside. He went home and did not return, but we learned later that he died December 1. The lungs and mediastinal structures were examined at postmortem, and, although careful search was made, no evidence of Hodgkin's disease was found; the mediastinal tumor had become entirely replaced by connective tissue.

Comment. The disease was quite advanced when the patient first applied for treatment. Even at the outset it was obvious that such improvement as it might be possible to bring about was likely to be short-lived. It is of interest, however, that, while patients who have had systematic treatment may not show any appreciable evidence of adenopathy, a time arrives sooner or later when their health begins to decline more or less rapidly until they die. Many such patients, during the last few months, complain of pain, generally boring in character and quite distressing, in one bone or in several. It is sometimes relieved by treatment directed to the region, but only for a short time.

CONCLUSIONS

The foregoing cases show conclusively that careful radiotherapy exerts a strikingly beneficial influence on the lymphatic hyperplasia incident to lymphosarcoma and Hodgkin's disease, and that the symptoms consequent on such adenopathy are relieved more or less completely for long or for short periods, depending on the more or less acute or chronic nature of the disease, on the stage it has reached when the treatment is started, and on the faithfulness of the patient's coöperation.

Except for special reasons, it is a mistake to limit the treatment to palpably enlarged nodes or masses of nodes. At the outset, it is wiser to make the treatment fairly general by directing it, not only to such nodes as may be palpable, but also to the mediastinal and lower paravertebral lymph chains.

Vol. XVII, No. 2

RADIUM AND HEMORRHAGE*

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THE susceptibility of normal and malignant cells to radium varies. The cell constituents of the blood, endothelial cells lining the blood vessels, connective tissue cells—muscular, cartilage and osseous—all react differently. Squamous or basal cell epithelioma; columnar or glandular cell carcinoma; lympho-, giant, small or round cell, fibro- or melanotic sarcoma, vary in their reaction to the rays of radium. In addition to the malignant cells, the presence of a connective tissue framework and that indefinite thing we call "reaction of the patient to irradiation," another factor enters into the problem which makes it still more complex, viz., the blood supply of the tissues irradiated.

The effect of radium on the blood is noticeable even before microscopic changes appear in the vessels. The effect varies with the dosage. A moderate dose has practically no effect on the red cells, although a very slight anemia may develop about the fourteenth day. The lymphocytes, taking the most susceptible of the normal cells, decrease in number within a few hours. This is followed by a subsequent increase which extends over a much longer period of time (Murphy and Taylor[1]). A polynuclear leucopenia occurs in about seven days. The blood platelets are primarily reduced for the first two to five days but return to normal about the twenty-second day. A subsequent rise occurs with its peak about the thirtieth day, the return to normal taking place in the neighborhood of the fortieth day (Mottram[2]). These investigators were able to produce by the use of small repeated doses of radium, a primary rise in the number of platelets, which was maintained for a few days only. This observation may be important in considering the relationship between platelets and coagulation of the blood. In irradiation of sufficient strength to produce radiation sickness, the blood shows at first a slight leucocytosis, which later passes into a leucopenia; the lymphocytes first increase but then diminish considerably. If the patient reacts, the blood gradually returns and at the end of four to six weeks presents a normal picture; or the patient may pass into a stage of cachexia due to permanent damage of the endocrine system (Hirsch[3]).

Clinical observations suggest that the blood at times becomes radioactive. In multiple lyphoma and sarcoma the writers have observed the disappearance of tumors at regions far remote from the point of irradiation. Animal experimentation is confirmatory. Murphy and Morton[4] showed that a substance appeared in the blood, following irradiation, which exerted a stimulating effect when mixed with lymphatic tissue *in vitro*, and recently dogs have been exposed to radium emanation sufficient to produce shock; the blood was then removed and the serum injected into other dogs subcutaneously, and it seemed to vaccinate them. After this, exposure of the vaccinated dogs to an equal amount of radium emanation was not followed by shock.

Normal cells of the body are resistant to the rays of radium. Janeway[5] states that the cells of epidermoid carcinoma are approximately four times as susceptible to the destructive action of the radium rays as are those of normal tissue. Prime[6] believes that the resistance of physically functioning cells to radium is due to the expenditure of their metabolic surplus in mechanical movements rather than in increasing in size and dividing as do cancer cells. Withers[7] is of the opinion that cells which secrete colloid or protein substances are less radioactive than those which secrete crystalloid or crystallizable material.

With the exception of the lymphocytes, the endothelial cells of the blood vessels are the most susceptible of the normal cells of the human body to the rays of radium.

* Read before the AMERICAN THERAPEUTIC SOCIETY, Atlantic City, N. J., May 23, 1925.

This explains why growths well supplied with lymph and blood vessels respond more readily to the action of radium. Following irradiation, the nucleus of the cancer cell is first affected, the power of mitosis being lost, and the cell subsequently dying. Associated with this, or directly following, the endothelial cells are affected. Those within range of the destructive beta rays are killed and, as a result, capillaries rupture. The nourishment of the tissue supplied is interfered with and

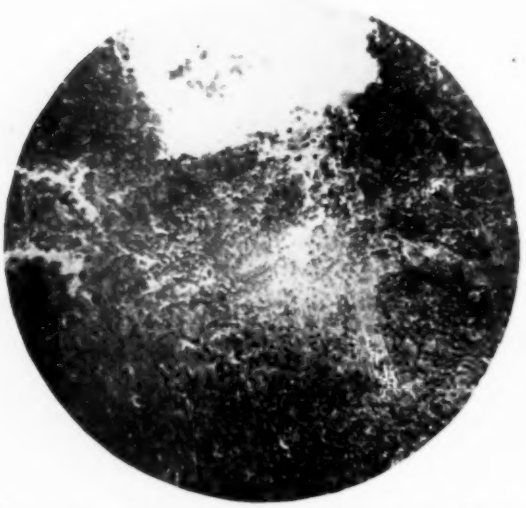

Fig. 1. Lymph gland removed twelve days after 300 mg-hr. radium implantation. Note swollen endothelium of capillary in lower right segment.

the destruction of the cells hastened. Endothelial cells at a greater distance are not destroyed outright but swell up, decreasing the lumen of the capillaries and consequently the amount of blood carried by them (Fig. 1). These capillaries, however, take part in the formation of granulation tissue, but later become surrounded by fibrous connective tissue and compressed.

It is observed, therefore, that the reaction of the endothelial cells to irradiation is secondary in importance only to the reaction of the cancer cells. Various observers believe that radium under certain conditions apparently stimulates cancer cells to further activity. This reaction to the rays of radium is demonstrated by endothelial cells, the capillaries increasing tremendously in the formation of connective tissue which follows the destruction of the cancer cells. Gudzent,[8] in describing this reaction, writes that "one observes the young connective tissue permeating in all directions. It breaks upon the cell complexes of the parenchyma, encircles single complexes, pressing them together and strangling them." The reaction of the endothelial cells also varies clinically with the type of rays. In lesions where both beta and gamma rays are used, the effect on the capillaries is noticeable early. Within forty-eight hours there is usually a diminution in the blood stained discharge; this may be associated with some edema in the tissue directly surrounding the growth. At the end of seven days there is a marked contraction of the capillaries and later many are completely destroyed by occlusion. At times, however, the character and distribution of the blood vessels is such that a favorable reaction is interfered with. Ewing attributes the resistance of certain epitheliomas to irradiation to the arteriosclerotic change in the blood vessels, together with the dense fibrous connective tissue which is usually found at the periphery of these growths.

The effect of the gamma rays of radium on carcinoma of the cervix is noted by Frankl and Amreich[9] as early as the third day after irradiation (600 mg-hr.), sections showing extensive vascularization in addition to edema of the growth. On the fifth day, after 1800 mg-hr., dilatation of the vessels in the papilla was still present. In their conclusions the authors were of the opinion that the influence of the rays was greatest between the fifth and seventh days and was no longer effective after the fortieth.

In sarcoma the effect of the rays on the blood vessels is more pronounced. Dominici and Rubens-Duval[10] observed in sections of myeloid sarcoma following irradiation that the blood vessels became smaller so that they appeared like capillaries lying in the midst of fibrous tissue. The susceptibility of certain sarcomas to irradiation depends to a great extent upon the structure of the walls of the vessels, there being for the most part a lack of development of the media and adventitia which under normal circumstances would partially filter the

rays, making the endothelium less susceptible to their action.

Vessels with normal walls seem to be highly resistant to the radium rays; in studying the reaction of the blood vessels to irradiation one must consider the density of the tissue through which the rays pass, so that the most nearly correct idea of the effect would be obtained by noting the changes in the vessels of all tissues under similar conditions. This is not possible at present, because experiments in most instances are conducted with the idea of determining the effect of the rays on the tissue of the animal exposed under circumstances similar to the exposure of the tissues in man.

One would expect the vessels of the brain to be susceptible to the rays of radium. Williamson, Brown and Butler[11] applied 50 mg. directly to the cortex in a dog for six hours. At the end of three weeks, microscopic examination showed that beyond the area of necrosis, which extended to a depth of 2 millimeters, the blood vessels were not destroyed and there was no hemorrhage. Six hundred mg-hr. at the end of three weeks produced a necrotic zone which extended to the depth of 0.5 cm., the vessel walls were thickened to three or four times their normal size, hyalinized and congested, but the walls were intact. Marking the periphery of the necrotic zone was a circle of hemorrhage and here the vessel walls while not thickened had ruptured; beyond this the blood vessels were congested. Nine hundred mg-hr. under similar conditions produced practically the same effect on the blood vessels (Fig. 2).

The blood vessels of the ovary are apparently highly resistant to the action of the gamma rays of radium. Weis[12] after exposing the rabbit ovary to 600 mg-hr. of radium, screened so that the gamma rays only were acting, could find no microscopic evidence of any endarteritis in the irradiated ovary at the end of four, six and eight weeks. The blood vessels were quite large and any change would have been easily noticed. In addition to this, there was no change in the germinal epithelium and no evidence to prove that the radium had any effect on the ova and maturing Graafian follicles. Two of three rabbits produced a normal litter after exposure to 600 mg-hr. Bower and Clark[13] also observed this in the microscopic examination of the ovaries of the leucemic female who became pregnant following large doses of the gamma rays of radium over an enlarged spleen, the ovaries being approximately 5 to 7 cm. distant from the radium pack. The changes were limited to a thickening of the subendothelial tissue (Fig. 3).

The blood vessels of the thyroid gland are even more resistant than those of the ovary. Microscopic examination of the thyroids of dogs after implantation of radium (Bower and Clark)[14] failed to show any marked change in the blood vessels, although in some instances occlusion by a subendothelial proliferation of fibrous tissue was observed at the end of three weeks. In thyroids removed some months after irradiation, the blood vessels were definitely sclerosed (Fig. 4).

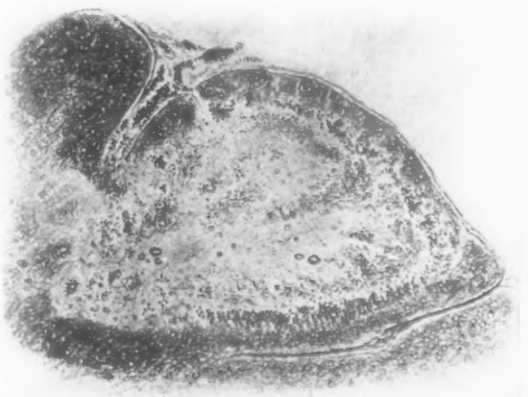

Fig. 2. Drawing showing central necrotic area with thickened blood vessels. Surrounding this is a circle of hemorrhage, and beyond this is an area of congestion (low power). (After Williamson, Brown and Butler.)

At times it is necessary to place radium close to the large blood vessels and while we have not seen any untoward results, we have theorized on the damage that might be done to the walls of these important structures. Recently, Dobrovolskaïa[15] placed radium capsules and needles close to the blood vessels in dogs and rabbits, and it was demonstrated that with the doses and filters used in clinical radium therapy, the changes induced by the hard gamma rays were minimal. This justifies

their application to deep regions exposed by operation.

Figure 5 illustrates well the high resistance of blood vessels of large caliber to radium. This is a camera lucida drawing of the deep femoral artery, removed eighteen months after 100 mg. of radium, screened by a brass capsule, had been within 2 cm. of it for 24 hours. The patient was suffering from a sarcoma of the lower thigh.

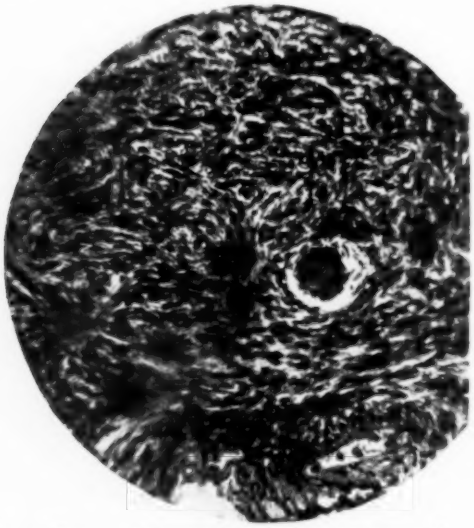

FIG. 3. Ovary of leucemic female after large doses of radium. Note primordial follicle and normal capillary.

FIG. 4. Thyroid of dog removed 210 days after 150 mg-hr. irradiation. Note extreme thickening—almost obliteration—of the blood vessels.

PRACTICAL CONSIDERATIONS

This report is based on the study of 78 cases of benign, precancerous and cancerous lesions of the vagina, uterus, bladder, kidney and rectum. Bleeding was the important symptom in seventy-four.

Uterine Bleeding. The control of idiopathic bleeding with the preservation of ovarian function is not difficult. The most interesting case was that of a young single woman (21) who gave a history of metrorrhagia for three years; this persisted even though dilatation and curettage had been done on two occasions by two gynecologists of good repute. She had a moderate secondary anemia; her coagulation time was four minutes. Glandular products, injections of serum, etc., were of no value. Fifty mg. of radium was introduced into the uterus for eight hours. The bleeding continued for four weeks without change then gradually ceased, her second period being practically normal. Since then, almost two years ago, she has menstruated every thirty-five days, usually of five days' duration. Her coagulation time has slightly increased and her blood count is normal.

Occasionally when these smaller doses are used, another application is necessary. This is demonstrated by the following case:

Female, aged thirty-two, in whom metrorrhagia continued following high amputation of the cervix and bilateral salpingectomy. She has a small tuberculous lesion in the right apex which became active after her first operation, at which numerous enlarged mesenteric glands were found with a moderate amount of free fluid in addition to the pelvic lesion. Seven hundred mg-hr. were given with little or no abatement of hemorrhage. After a lapse of four months, 50 mg. were introduced for 24 hours (1200 mg-hr.). There was an immediate cessation of bleeding except for a slight show three weeks later. Three months after the last application she had gained 9 pounds, the blood picture had improved and the coagulation time decreased. Despite her age, the large dose of radium was justified, we felt, because she was rapidly losing weight.

In the arteriosclerotic uterus of the menopause, radium is almost a specific, although large doses must be employed. This can readily be understood if one remembers the thickness of the blood

vessels that must be affected (Fig. 6). Figure 7 shows the effect of irradiation on the capillaries of the endometrium.

With small fibroids, 5 to 8 cm. in diameter, in women before the menopause, who have had children, or do not desire to have them, we usually give 50 mg. for from twelve to fourteen hours. We have not used radium in fibroids larger than a four and one-half months pregnant uterus, except where operation was contraindicated. Radium will control hemorrhage in the larger ones but usually the reduction in size is slow. We have not irradiated large fibroids with small pedicles although we have had one such patient, a woman aged seventy, whose physical condition precluded a radical operation. Hemorrhage was controlled and there was slight reduction in the size of the growth. In all instances, a single dose of 1200 mg-hr. has been sufficient to check bleeding. Where a reduction in size was desired, repeated doses have been given. Occasionally the cessation of bleeding will be delayed; sometimes three weeks will elapse without any diminution, but if the coagulation time is normal, the Wassermann reaction negative, and there is no pelvic lesion, hemorrhage will cease. Where the full dose has been given, it has not been necessary to repeat to control hemorrhage.

In the precancerous lesions of the cervix, the blood-stained discharge stopped. In cancers of the cervix (16 in number) the hemorrhage and the associated fetid discharge ceased and in cancer of the fundus (one subsequently removed) the bleeding and discharge stopped. While we realize that the destruction of the cancer cell, not only in the initial lesions but in the metastatic gland, is the all-important consideration, the cessation of hemorrhage is an indication of the lethal effects of the rays locally. Therefore, any escape of blood from the diseased area is an indication for more radium, provided a previously unfavorable general reaction has not taken place, i.e., a marked reduction in the number of lymphocytes. Animal experimentation shows that "radiation summation ceases at the end of seven days," so we have been irradiating our patients having cancers of the uterus, every seven days, the average case receiving between 6000 and 7000 mg-hr.

Renal Bleeding. The hemostatic action of radium was remarkably demonstrated in a patient suffering from hematuria due to a papilloma of the left kidney. She was a diabetic, fifty-four years of age, who had been bleeding nine months prior to admission. This was controlled by nitroglycerine. One month later hematuria returned and continued intermittently for thirty days.

FIG. 5. Deep femoral artery removed eighteen months after 2400 mg-hr. irradiation. The thickening of the intima is no greater than that found normally in adults.

It then became continuous, the urine being of a bright red color for the twenty-four days prior to admission to the hospital. The hemoglobin at this time was 45 per cent. Her general condition was such that operation was not advised. Cystoscopic examination revealed bleeding from the left kidney. Nitroglycerine, gallic acid, tincture ferric chloride, ergot, thyroid extract, oil erigeron, turpentine, and hemostatic serum were all used without effect. Finally 100 mg. of radium was applied for eighteen hours over the kidney area. On the third day after application, the urine became lighter, on the fifth day it was almost clear

and on the sixth entirely clear; on the eleventh day the patient was permitted to be out of bed. Thirteen days after irradiation the hemoglobin had risen from 42 to 50 per cent, the red cells had increased from less than 2,000,000 to 2,300,000 and her general condition had markedly improved.

Rectal Bleeding. Bleeding in carcinoma of the rectum was completely checked in 12 of 13 cases in which radium was applied.

FIG. 6. Sclerosed small arteries in uterus resistant to small doses of radium.

We used radium in these cases as a preliminary to resection, either before or after a colostomy. A woman, aged sixty-six, with a large carcinoma of the rectosigmoid, developed severe rectal pain and for ten months following operation passed per anum about one ounce of blood daily. A colostomy had been done previously, a resection not being considered on account of a thrombosis of the femoral vein. Radium applied to the growth through the anus and the colostomy opening above, controlled both pain and hemorrhage within fourteen days. In another case in which resection was preceded by colostomy and crossfire irradiation, bleeding was controlled in ten days. This patient is alive after four years. These are the favorable cases. Radiation sufficient to control hemorrhage in cases in which a resection cannot be done, frequently produces pain but prolongs life. These patients usually gain in weight after six weeks.

Vesical Bleeding. Hemorrhage from the bladder, whether benign or malignant in origin, can be controlled by radium properly applied. Our experience has not been great, but sufficient to advise its application as a curative method in benign lesions and as a hemostatic in malignant growths, thus permitting cystoscopic inspection and enabling the operator to determine better the exact procedure that will give his patient the best chance.

FIG. 7. Hyaline changes in capillaries of endometrium following irradiation.

CONCLUSIONS

1. The endothelial cells lining the blood vessels are the most susceptible of the normal cells of the human body to the action of the rays of radium, with the exception of the lymphocytes.

2. The endothelial cells are apparently stimulated to proliferation following the destruction of the cancer cells, resulting in a tremendous increase in capillaries, the forerunners of connective tissue.

3. Cessation of bleeding, following the treatment of cancer by radium, is an indication of the lethal effect of the rays, cancer cells being more susceptible than the endothelial cells.

4. Cessation of bleeding following the treatment of benign lesions by radium indicates the local obliterative effect on the superficial vessels.

5. Normal blood vessels, larger than

capillaries are highly resistant to the action of the radium rays, especially the hard gamma rays.

6. The amount of radium sufficient to stop idiopathic hemorrhage or hemorrhage due to benign uterine growths, produces no demonstrable microscopic change in the ovarian blood vessels or Graafian follicles.

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A ROENTGEN-ANATOMICAL STUDY OF THE COLON ON ONE HUNDRED AND FIFTY PATIENTS WITH PULMONARY TUBERCULOSIS

BY

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IN connection with the customary routine roentgen-ray examination of the bowels, employed in the Trudeau Sanatorium since 1920 for the early diagnosis of intestinal tuberculosis, a special study was made by the writers to secure by roentgenological methods anatomical data on the colon in regard to its shape, its position and its peritoneal and topographical relationships in patients with pulmonary tuberculosis. This was done in the hope that by systematically applied methods of investigation some light might be obtained on two important questions. First, whether the colon shows by roentgenological methods any characteristics peculiar to tuberculous individuals; and second, whether certain anatomical features of the colon (viz., shape, position, peritoneal and topographical relationships) in those cases in which intestinal tuberculosis has at any time complicated the pulmonary lesion, differ from those in the uncomplicated cases. The findings in 150 patients, 75 of whom were male and 75 female, are reported in this preliminary communication. Most of the cases studied were between twenty and forty years of age, only 9 (6 male, 3 female) were under 20 and 11 (7 male, 4 female) above 40, the youngest patient

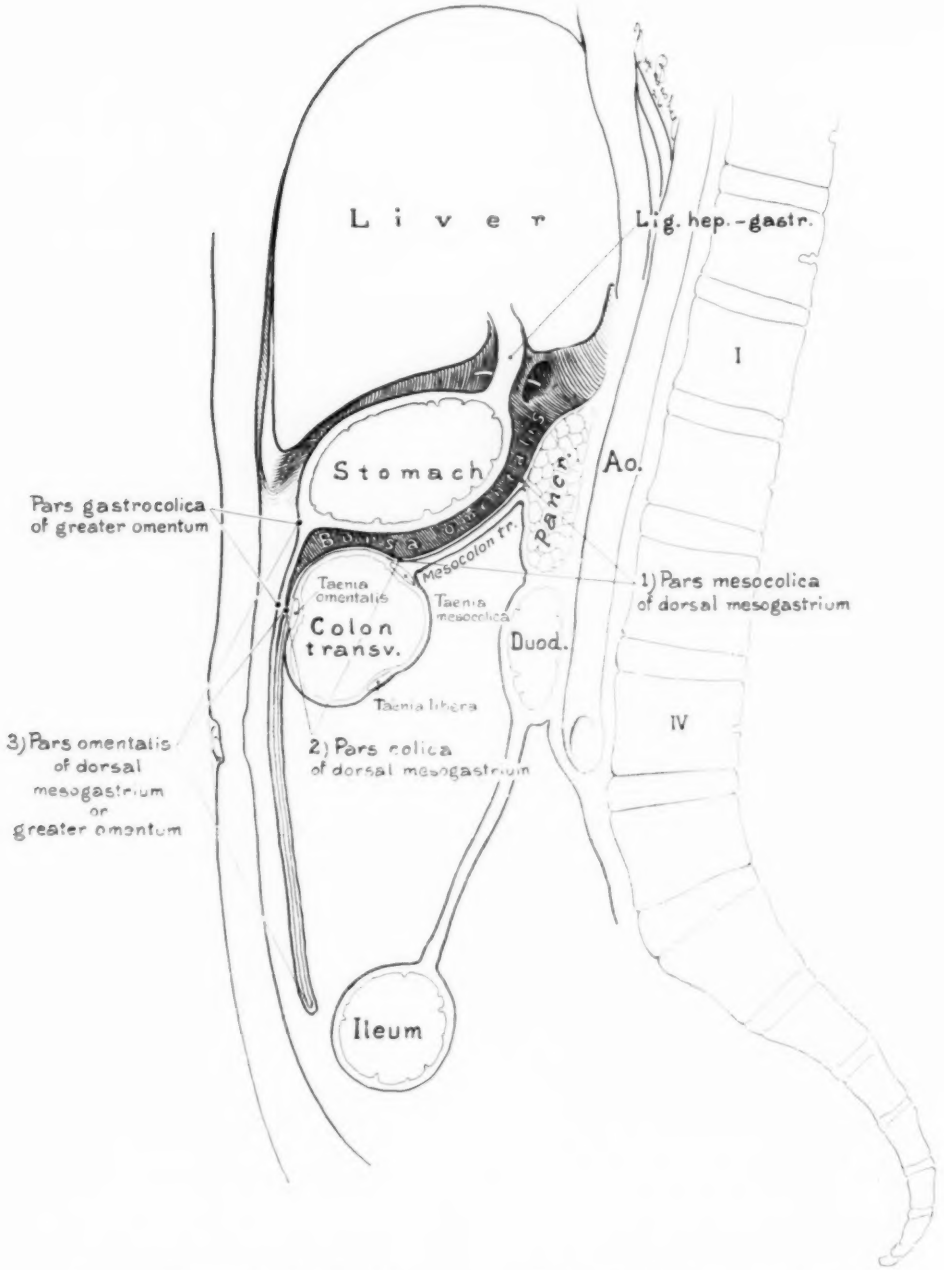

FIG. 1. Diagram by Max Brödel, showing the divisions of the dorsal mesogastrium.

By growth in length and by secondary fusion the dorsal mesogastrium becomes divided into the following parts: (1) the *pars mesocolica* of the dorsal mesogastrium, i.e., the portion fused with the transverse mesocolon in its extent from the posterior abdominal wall to the taenia mesocolica; (2) the *pars colica* of the dorsal mesogastrium, which is fused with the transverse colon between its taenia mesocolica and taenia omentalis; and (3) the *pars omentalis* of the dorsal mesogastrium, the greater omentum. The portion of the greater omentum, between the taenia omentalis of the transverse colon and the greater curvature of the stomach is called the *pars gastrocolica* of the greater omentum or the gastrocolic ligament. If the fusion of the ventral and the dorsal layers of the greater omentum fail to develop up to the taenia omentalis of the transverse colon, a deep recessus inferior bursae omentalis and absence of the so-called gastrocolic ligament result.

being fifteen and the oldest forty-six years of age.

METHOD

Included in this series are only those cases in which twenty-five hours after the barium meal the colon was sufficiently outlined to determine its shape, position and relation to the stomach, the latter being made visible by a second meal consisting of about 50 c.c. of the barium mixture administered during the roentgenoscopic examination. If intestinal tuberculosis complicated the pulmonary lesion at the time of observation the case was at first ruled out because by the twenty-fifth hour practically all of the barium had been eliminated. Such cases, however, were included in the series as soon as they retained sufficient barium to outline the colon twenty-five hours after ingestion (i.e., as soon as such positive cases became negative).

The information concerning the position of the ileocecal portion of the gut (terminal portion of the ileum, cecum and appendix), the shape of the colon, and the relative position of the transverse colon to the stomach was obtained by roentgenoscopic examinations. Also the presence of additional peritoneal connections about the hepatic and splenic flexures of the colon and the presence or absence of the gastro-

FIG. 2. *Perfect fusion* of the layers of the greater omentum along the taenia omentalis of the transverse colon was inferred in this case, because the greater curvature of the stomach and the transverse colon lay parallel and close to each other and their relative position remained about the same during palpation.

Male, aged nineteen (S. No. 7093). *Cecum:* on the linea terminalis (i.e., in 3d position). *Ascending colon:* long, shape, dextro-convex. *Flexura coli dextra:* at the level of the 3d lumbar vertebra; right angle. *Transverse colon:* shape, regular and caudo-convex, parallel and close to the greater curvature of the stomach; lowest point of the latter at the level of the 4th lumbar vertebra; lowest point of the transverse colon at the level of the 5th lumbar vertebra. *Flexura coli sinistra:* at the level of the 2d lumbar vertebra, acute angle. *Descending colon* and *sigmoid* outlined.

FIG. 3. *Non-fusion* of the layers of the greater omentum along the taenia omentalis of the transverse colon was inferred in this case because the stomach lay high and the transverse colon lower in the abdominal cavity with greater space in between (coloptosis).

Female, aged twenty-five (S. No. 6690). *Cecum:* on the linea terminalis (i.e., in 3d position). *Ascending colon:* length, average; shape, dextro-convex. *Flexura coli dextra:* at the level of the 4th lumbar vertebra; the two arms of the angle lay parallel for more than half of the length of the ascending colon; presence of adhesions inferred. *Transverse colon:* shape, regular and caudo-convex; distant from the greater curvature of the stomach. Lowest point of the latter at the level of the 3d lumbar vertebra; lowest point of the transverse colon near the level of the symphysis. *Flexura coli sinistra:* at the level of the 3d lumbar vertebra. *Descending colon:* outlined.

colic portion of the greater omentum (ligamentum gastrocolicum) were determined with a certain degree of probability by the same method. The skeletotopic relationship (i.e., position of viscus in relation to skeleton) of the cecum, ascending colon, the hepatic flexure, the transverse colon, the splenic flexure, the descending colon and sigmoid, and the greater curvature of the stomach was studied on roentgenograms.

Roentgenoscopic examinations were made in the horizontal position, seven, eight and nine hours after the barium meal and again in the upright position twenty-five hours after the meal. An eight-hour film was taken in the prone position and a twenty-five hour film in the upright position.* These roentgenograms with the notes made during the roentgenoscopic examinations were the records used in preparing this paper. However, for the sake of uniformity and the possibility of comparison, the most extensive use was made of findings in the upright position twenty-five hours after the barium meal.

FIGS. 4–6. *Imperfect-fusion* of the layers of the greater omentum along the taenia omentalis of the transverse colon was inferred in these cases because the greater curvature of the stomach and the transverse colon lay close and parallel on the one side but distant on the other.

FIG. 4. *Male*, aged twenty-eight (S. No. 6957). *Cecum:* on the linea terminalis, (i.e., in 3d position). *Ascending colon:* long; shape, dextro-convex. *Flexura coli dextra:* at the level of the 2d lumbar vertebra; the two arms of the angle lay parallel more than half of the length of the ascending colon; presence of adhesions inferred. *Transverse colon:* shape, regular and caudo-convex; lowest point about the level of the 5th lumbar vertebra; close and parallel with the greater curvature of the stomach on the left, distant on the right. Lowest point of the greater curvature of the stomach at the level of the 4th lumbar vertebra.

* In taking the films in both the upright and prone postures, the position of the Coolidge tube was such that the central ray passed perpendicularly through the body at about the level of the fifth lumbar vertebra. Occasionally, when the colon shadow lay unusually high or very low, the tube was raised or lowered respectively in order not to distort relative positions. The tube was always in the median line.

Thus all the data refer, unless otherwise noted, to findings in the upright position and roentgenograms mentioned are twenty-five hour films taken in the same position.

ANATOMICAL AND EMBRYOLOGICAL CONSIDERATIONS

The form of the colon as a whole is determined anatomically by the shape, length and relative position of its individual parts. The ascending and the descending colon being fixed to the posterior abdominal wall in a secondary retroperitoneal position are less movable than the transverse colon or the sigmoid which have retained their mesocolon. In general, when speaking of the form of the colon the sigmoid is not usually considered. Variations in the shape and position of the rest of the colon are most frequently due to variations found in the transverse colon which is the longest and relatively most movable portion.

The shape and position of the transverse colon, when there is no general splanchnoptosis or weakening of the ventral wall of the abdomen, depends mainly: (1) on the length of its mesocolon in both the ventrodorsal and the transverse directions; (2) on the length of the transverse colon measured between the hepatic and splenic flexures, and (3) on the skeletal level and relative position of the highest point of both flexures. Among other factors also having an influence upon the shape and position of the transverse colon, the presence of some additional but not necessarily pathological peritoneal connec-

FIG. 5. *Male*, aged forty-one (S. No. 7009). *Cecum:* in the fossa iliaca (i.e., in 2d position). *Ascending colon:* short; shape, dextro-convex. *Flexura coli dextra:* at the level of the 4th lumbar vertebra; acute angle. *Transverse colon:* shape, regular and caudo-convex; lowest point on the left and below the level of the promontorium; close and parallel with the greater curvature of the stomach on the right, distant on the left. Lowest point of the greater curvature of the stomach at the level of the 5th lumbar vertebra. *Flexura coli sinistra:* at the level of the 3d lumbar vertebra. Adhesions between the last portion of the transverse colon and the entire length of the descending colon inferred.

FIG. 6. *Male*, aged twenty-nine (S. No. 7006). *Cecum:* on the linea terminalis (i.e., in 3d position). Ascending colon: length, average; shape dextro-convex. *Flexura coli dextra:* at the level of the 3d lumbar vertebra; right angle. *Transverse colon:* shape, regular and caudo-convex; lowest point about the level of the 5th lumbar vertebra; close and parallel with the greater curvature of the stomach on the right, distant on the left. Lowest point of the greater curvature of the stomach at the level of the 4th lumbar vertebra. *Flexura coli sinistra:* about the level of the 1st lumbar vertebra; adhesions between the last portion of the transverse colon and more than half of the length of the descending colon inferred.

tions, between parts of the colon, have to be mentioned. While these, mostly congenital peritoneal connections found usually about the hepatic and splenic flexures, have been frequently noted and their clinical importance again and again emphasized, little attention has been given to the influence of the non-fusion of the ventral and the dorsal layers of the greater omentum (i.e., the absence of the gastrocolic portion of the greater omentum—the so-called gastrocolic ligament) upon the position of the transverse colon itself and upon its relative position to the stomach.

FIG. 7. *Irregular fusion* of the layers of the greater omentum along the taenia omentalis of the transverse colon was inferred in this case because the transverse colon and the greater curvature of the stomach lay close and parallel on the right and left sides but distant in the middle, where a descending and ascending arm of the V-shaped middle portion of the transverse colon could not be easily and entirely separated by palpation.

Male, aged forty-three (S. No. 7078). *Cecum:* in the fossa iliaca (i.e., in 2d position). *Ascending colon:* length, average; shape, dextro-convex. *Flexura coli dextra:* at the level of the 4th lumbar vertebra; acute angle. *Transverse colon:* V-shaped, caudo-convex; lowest point below the level of the promontorium. Lowest point of the greater curvature of the stomach at the level of the 5th lumbar vertebra. The presence of some additional peritoneal connections between the descending and ascending arms of the V-shaped middle portion of the transverse colon was inferred and also a non-fusion of the layers of the greater omentum along the taenia omentalis of the same portion of the transverse colon was deduced.

Embryology designates the peritoneal layer between the greater curvature of the stomach and the posterior abdominal wall as the dorsal mesogastrium (see Fig. 1). By growth in length and by secondary fusion the dorsal mesogastrium becomes divided into the following parts: (1) the *pars mesocolica* of the dorsal mesogastrium, i.e., that portion which is fused with the transverse mesocolon in its extent from the posterior abdominal wall to the taenia mesocolica; (2) the *pars colica* of the dorsal mesogastrium which is fused with the transverse colon between its taenia mesocolica and taenia omentalis, and (3) the *pars omentalis* of the dorsal mesogastrium, the greater omentum. This latter has a *dorsal* and a *ventral* layer. The dorsal layer begins at the taenia omentalis of the transverse colon and extends downward various distances returning as the ventral layer to the greater curvature of the stomach. These, the ventral and dorsal layers, are fused as far as the taenia omentalis of the transverse colon and hang like an apron covering the loops of the small intestine. That portion of the greater omentum, between the taenia omentalis of the transverse colon and the greater curvature of the stomach is called the *pars gastrocolica* of the greater omentum or the gastrocolic ligament. If, however, the fusion of the ventral and the dorsal layers of the greater omentum fail to develop up to the taenia omentalis of the transverse colon, a deep *recessus inferior bursae omentalis* and absence of the so-called gastrocolic ligament result.

In previous studies on the peritoneal and topographical relationship of the abdominal organs in a large number of cadavers, it was noticed by one of the writers that whenever this condition prevailed (i.e., failure of fusion of the ventral and the dorsal layers of the greater omentum) the transverse colon was found lower in the abdominal cavity, the distance between the greater curvature of the stomach and the transverse colon being greater than usual. Thus the decided

influence of the presence or absence of the gastrocolic portion of the greater omentum upon the position of the transverse colon and upon its relative position to the stomach was firmly established. The attempt was next made to identify this condition, i.e., the non-fusion, as well as the imperfect and the perfect fusion of the ventral and the dorsal layers of the

(1) If the greater curvature of the stomach and the transverse colon lay parallel and close to each other, and their relative position remained about the same during palpation, a *perfect fusion* of the layers of the greater omentum was inferred (Fig. 2). (2) A *non-fusion* of the layers was deduced: (*a*) if the stomach lay high and the transverse colon lower down in the

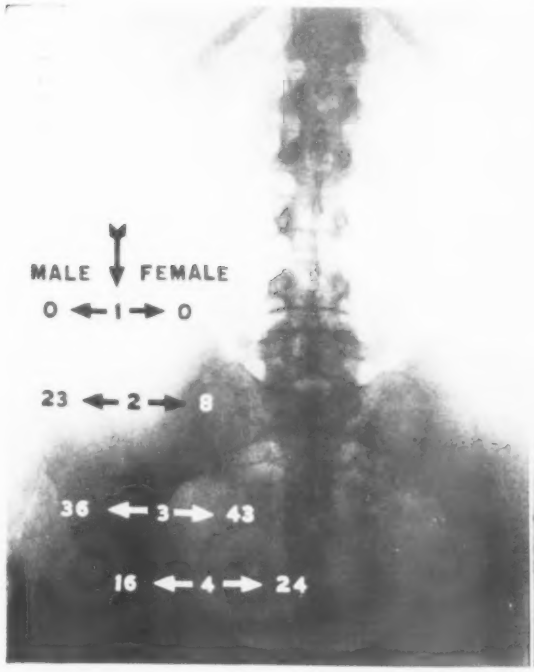

FIG. 8. Showing the position of the cecum in relation to the skeleton. In none of our cases was the cecum situated in the *1st position*, i.e., on the crista iliaca. In the *2d position*, i.e., in the fossa iliaca, it was found in 23 males and 8 females (about 21 per cent of the cases); in the *3d position*, i.e., on the linea terminalis (slightly above or below) in 36 males and 43 females (52 per cent of the cases); in the *4th position*, i.e., in the pelvis minor in 16 males and 24 females (about 27 per cent of the cases).

FIG. 9. A part of the greater curvature of the stomach is seen below the transverse colon, the shape of which is regular and cranio-convex.

Male, aged twenty-one (S. No. 7044). *Cecum:* on the linea terminalis (i.e., in 3d position). *Ascending colon:* length, average; shape, dextro-convex. *Flexura coli dextra:* at the level of the 3d lumbar vertebra; right angle. *Transverse colon:* shape, regular and cranio-convex; peak of convexity at the level of the 3d lumbar vertebra. Lowest point of the greater curvature of the stomach below the level of the promontorium.

greater omentum, in the living, by roentgenological methods. Corresponding to these previous anatomical findings on the cadaver, (1) the *perfect fusion*, (2) the *non-fusion*, (3) the *imperfect fusion*, and (4) the *irregular fusion* of the layers of the greater omentum along the taenia omentalis of the transverse colon were judged, on the living, by the relative position of the transverse colon to the stomach as seen during roentgenoscopic examination and found by palpation, and on the roentgenograms.

abdominal cavity, with greater space in between (coloptosis) (Fig. 3); (*b*) if the stomach could be easily separated from the transverse colon without materially disturbing the position of the latter, i.e., when the stomach could be raised without the transverse colon following it. (3) An *imperfect fusion* was inferred if the greater curvature of the stomach and the transverse colon lay parallel but distant on the one side and close on the other (Figs. 4–6).

(4) An *irregular fusion* was deduced when the course of the transverse colon was irregular and in some places distant from the greater curvature of the stomach, at others, the two were close and parallel (Fig. 7).

THE CECUM AND THE COLON ASCENDENS

In our classification the cecum was in *1st position* if it lay on the crista iliaca or higher; in *2d position*, if in the fossa iliaca; in *3d position*, if on the linea terminalis (slightly above or below); and in *4th position*, if situated in the pelvis minor (Fig. 8).

In none of our cases was the cecum situated in the *1st position*, i.e., near the crista iliaca*; in the *2d position*, i.e., in the fossa iliaca it was found in 31 cases (23 male, 8 female) or about 21 per cent; in the *3d position*, i.e., on the linea terminalis, in 79 cases (36 male, 43 female) or about 52 per cent; in the *4th position*, i.e., in the pelvis minor, in 40 cases (16 male, 24 female) or about 27 per cent.

These findings differ from those reported recently by Moody, Chamberlain and Van Nuys, who found the cecum in 60 per cent of 300 healthy males and 63 per cent of the same number of healthy females "in the cavity of the true pelvis," if "subject in the anatomical position."

The ascending colon was dextro-convex

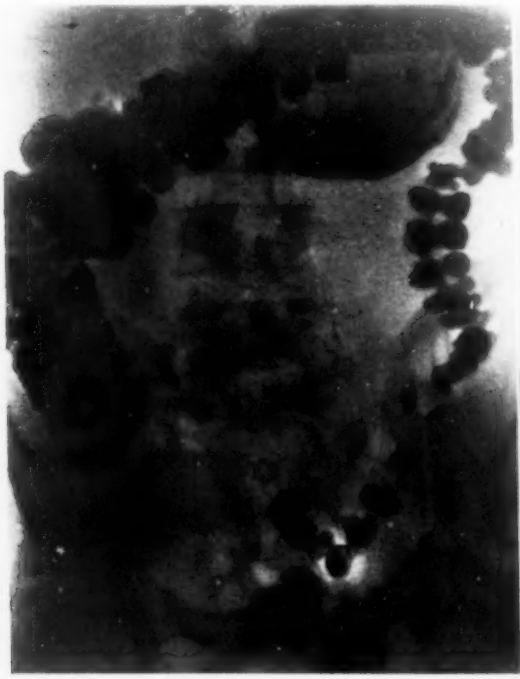

FIG. 10. A part of the greater curvature of the stomach is seen below the transverse colon, the shape of which is regular and slightly cranio-convex.

Male, aged thirty-two (S. No. 7010). *Cecum:* in the fossa iliaca (i.e., in 2d position). *Ascending colon:* length, average; shape, dextro-convex. *Flexura coli dextra:* at the level of the 2d lumbar vertebra; the two arms of the angle lay parallel less than half of the length of the ascending colon; presence of adhesions inferred. *Transverse colon:* shape, regular and slightly cranio-convex; peak of convexity about the level of the 1st lumbar vertebra. Lowest point of the greater curvature of the stomach at the level of the 3d lumbar vertebra. *Flexura coli sinistra:* at the level of the 1st lumbar vertebra. *Descending colon* and *sigmoid* outlined.

FIG. 11. A part of the greater curvature of the stomach is seen below the level of the transverse colon.

Female, aged twenty-seven (S. No. 7004). *Cecum:* in the pelvis minor (i.e., in 4th position). *Ascending colon:* length, average; shape, dextro-convex. *Flexura coli dextra:* at the level of the 4th lumbar vertebra; the two arms of the angle lay parallel for about half of the length of the ascending colon; presence of adhesions inferred. *Transverse colon:* shape, regular and cranio-convex on the left side of the vertebral column; peak of convexity at the level of the 4th lumbar vertebra. Lowest point of the greater curvature of the stomach below the level of the promontorium.

*Thorsch reported in his series of 115 cadavers, 4 in which "the tip of the caecum lay higher than the spina iliaca."

in all the cases in which the cecum lay in the 3d or 4th position; these groups comprised approximately 80 per cent of the total. In those in which the cecum occupied the 2d position (only 31 cases) the ascending colon was straighter.

According to length, the ascending colon was classified into three groups: (*a*) average, (*b*) long, (*c*) short. If the hepatic flexure was at the level of the third or fourth lumbar vertebra (i.e., at L_3 or L_4) and the cecum in the 2d or 3d position respectively, the length was considered average. Deviation from this group was considered long or short respectively. The length of the ascending colon was found *average* in 84 cases (42 male, 42 female) or 56 per cent, *long* in 45 cases (22 male, 23 female) or 30 per cent, *short* in 21 cases (11 male, 10 female) or 14 per cent.

THE FLEXURA COLI DEXTRA

In 92 (42 male and 50 female) or about 61 per cent of the 150 cases the hepatic flexure (flexura coli dextra) was situated at the level of the fourth lumbar vertebra (L_4); in 22 or about 15 per cent below (6 male, 16 female, all at L_5); and in 36 or 24 per cent above. Of those found above the level of the fourth lumbar vertebra 26 (19 male, 7 female) were at L_3, 9 (7 male, 2 female) at L_2, and one (male) at L_1.

In only 16 cases (9 male and 7 female) did the ascending colon turn into the transverse colon at approximately a right angle. In all the other cases (134) the hepatic flexure was an acute angle. In 100 of these (49 male, 51 female) the first portion of the transverse colon lay parallel with the ascending colon; in 57 cases for less or half of the length, in 43 for *more than half* the length of the ascending colon. Out of these 100 cases in which the transverse colon lay parallel with the ascending colon for any distance, the presence of adhesions about the hepatic flexure was inferred in 84 cases (56 per cent) because the two arms of the angle could not be easily or entirely separated by palpation during the roentgenoscopic examination.

THE COLON TRANSVERSUM

In all but two cases, the transverse colon was *caudo-convex*. In Figures 9 and 10 the two cases (both male) are shown in which it was found cranio-convex.* The bow described by the transverse colon was regular in 132 cases: in the balance (18 cases) its course was irregular. The irregularity occurred usually on the right half, near the hepatic flexure or the middle of the transverse colon (Fig. 7). This irregularity was attributed to the coincidence

FIG. 12. A part of the sigmoid is seen above the level of the transverse colon.

Female, aged twenty-three (S. No. 7050). *Cecum:* in the pelvis minor (i.e., in 4th position). *Ascending colon:* length, average; shape, dextro-convex. *Flexura coli dextra:* at the level of the 5th lumbar vertebra; the two arms of the angle lay parallel for more than half of the length of the ascending colon; presence of adhesions inferred. *Transverse colon:* shape, regular and caudo-convex; lowest point below the level of the promontorium and near the symphysis ossium pubis. Lowest point of the greater curvature of the stomach below the level of the promontorium (gastro-coloptosis). Absence of the fusion of the layers of the greater omentum along the taenia omentalis of the transverse colon was inferred in this case because the stomach could be easily raised without the transverse colon following it. *Flexura coli sinistra:* at the level of the 4th lumbar vertebra. *Descending colon:* not outlined. A part of the sigmoid is seen above the level of the transverse colon.

of (1) an imperfect and irregular fusion of the layers of the greater omentum along

* Thorsch found the transverse colon cranio-convex in 12 per cent of 68, Kuprijanoff in 11 per cent of 100 cadavers.

the taenia omentalis of the transverse colon, and of (2) the presence of some additional but not necessarily pathological fusion of the peritoneal covering, forming connecting bands between parts of the colon.

The position and the relative position of the transverse colon and the greater curvature of the stomach. In all but three cases, the transverse colon was found at a lower level than the greater curvature of the stomach. The two lay *close* and *parallel* in 83 cases (47 male, 36 female), *distant* in 64 cases (26 male, 38 female). The remaining 3 cases (2 male, 1 female) in which a part of the greater curvature of the stomach was seen below the transverse colon are shown in Figures 9, 10, and 11.

(1) *Perfect fusion*, (2) *non-fusion*, (3) *imperfect fusion* and (4) *irregular fusion* of the layers of the greater omentum were judged, as stated before, by the relative position of the stomach and the transverse colon as seen during roentgenoscopic examination, during palpation and on roentgenograms. (1) A *perfect fusion* was inferred in 66 cases or 44 per cent (44 in male, 22 in female); (2) a *non-fusion*, i.e., an absence of the gastrocolic ligament in 50 cases or about 33 per cent (15 in male, 35 in female); and (3) an *imperfect fusion* in 22 cases or about 15 per cent (9 in male, 13 in female); and (4) an *irregular fusion* was deduced in 9 cases or 6 per cent (5 in male, 4 in female).*

The most dependent portion of the transverse colon was located above the level of the promontorium in only 43 cases or about 29 per cent (1 at L_1, 4 at L_3, 7 at L_4 and 31 at L_5). In the rest, 107 cases or about 71 per cent, it was found below the level of the promontorium, 31 of which were even lower, i.e., near the level of the symphysis (Fig. 12).

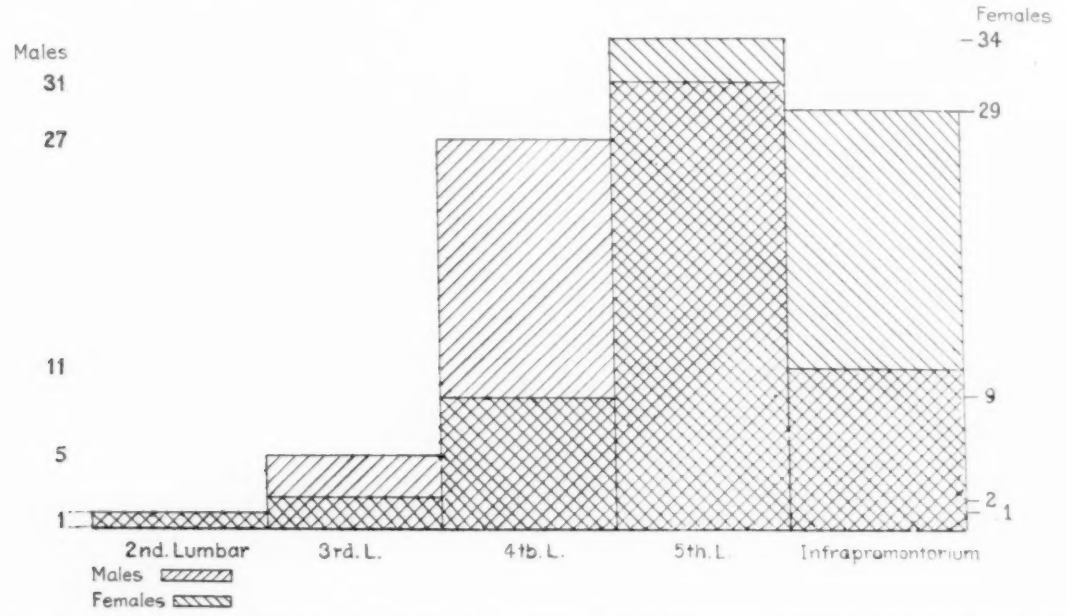

FIG. 13. In this chart is shown the skeletal level of the lowest point of the greater curvature of the stomach in males and females. This point was found, as an average, to reach one vertebra lower in females than in males.

It is interesting to note that of the 43 cases in which the transverse colon was above the level of the promontorium 34 were males. Thus the transverse colon was found above the level of the promontorium in about 45 per cent of the males (24 at L_5, 6 at L_4, 3 at L_3 and 1 at L_1) and in only 12 per cent of the females (7 at L_5, 1 at L_4 and 1 at L_3).

The lowest point of the greater curvature of the stomach was found above the level of the fourth lumbar vertebra in only 9 cases or 6 per cent (2 at L_2 and 7

* The three cases (2 per cent) in which a part of the greater curvature of the stomach was seen below the transverse colon are not included in these figures.

at L_3). In the rest, or 141 cases, the convexity reached lower than the level of the third lumbar vertebra. It was found in 37 cases (about 25 per cent) at the level of L_4, in 64 (about 42 per cent) at the level of L_5, and in 40 cases (about 27 per cent) below the level of the promontorium. In the majority of the males the lowest point of the greater curvature of the stomach lay at the level of the fourth or the fifth lumbar vertebra (27 at L_4, 31 at L_5) and in only 11 cases did it reach lower than the level of the promontorium. In females, on the other hand, the lowest point was found in the majority of the cases at the level of the fifth lumbar vertebra (L_5 in 34 cases) or below the promontorium (in 29 cases). In males there were 6 cases in which it was above the level of the fourth lumbar vertebra (1 at L_2, 5 at L_3) and in females 12 cases in which it was above the level of the fifth lumbar vertebra (1 at L_2, 2 at L_3 and only 9 at L_4; compared with the 27 in males). The greater curvature of the stomach was thus found, as an average, to reach lower in females by the height of the body of one vertebra, than in males (Fig. 13).

THE FLEXURA COLI SINISTRA

In 18 cases the last portion of the transverse and the 1st portion of the descending colon did not contain sufficient barium to determine the position of the splenic flexure (flexura coli sinistra). In 60 (26 male, 34 female) out of the remaining 132 cases the splenic flexure was found at the level of the third lumbar vertebra (L_3); in 42 (27 male, 15 female) it was *above*, and in 30 *below*, (12 male, 18 female). In those found *above* the level of the third lumbar vertebra 32 (18 male, 14 female) were at L_2, 8 (7 male, 1 female) were at L_1, and 3 (all male) at Th_{12}. In those found *below* the level of the third lumbar vertebra, 28 (12 male, 16 female) were at L_4, and 2 (both female) at L_5. The presence of adhesions between the transverse and the

Fig. 14.

Fig. 15.

Figs. 14 and 15. Excessive mobility of the sigmoid due to an unusually long mesocolon sigmoideum and persistence of the mesocolon descendens (in a boy under ten years of age).

descending colon was inferred in 55 cases or about 42 per cent of the 132 cases in which the splenic flexure was properly outlined.

THE COLON DESCENDENS AND THE COLON SIGMOIDEUM

The descending colon and the sigmoid will not be discussed here in detail because in most of our cases they were empty at the time of observation. It is clearly demonstrated in the case shown in Figures 14 and 15 that the shape and position of the sigmoid are determined primarily by the length of its mesocolon. In this case an excessive mobility of the sigmoid and the descending colon were present due to an unusually long mesocolon sigmoideum and to a persistence of the mesocolon descendens. In the case shown in Figure 16 the sigmoid was congenitally adherent to the left surface of the mesentery of the small intestine and therefore did not enter the pelvis minor on the left side as it does usually, but on the right.*

FIG. 16. The sigmoid was congenitally adherent to the left surface of the mesentery of the small intestine and therefore did not enter the pelvis minor on the left side as usually but on the right.

This photograph was taken from a new-born who lived two and one-half hours. The pathological diagnosis was: partus praematurus; thrombosis of Vv. terminales, Vv. cerebri internae, V. cerebri magna [Galeni], due to trauma during birth.

It is well also to remember that in some instances the sigmoid may be seen above the transverse colon by roentgenoscopic examination as in Figure 12. This naturally occurs only when the transverse colon has a low position.

DISCUSSION

In only a few cases of this series did the colon as a whole have the shape and position as described in textbooks of anatomy. In the great majority, variations from that considered as normal by anatomists were found, and attributed, on the one hand, to the presence of some additional, but not necessarily pathological, fusion of the peritoneal covering forming connecting bands and ligaments mostly about the hepatic and splenic flexures and, on the other hand, to non-fusion, imperfect, or irregular fusion of the layers of the greater omentum. Such anomalies as situs inversus, mesenterium commune, incomplete rotation of the colon, etc., were not seen in this series and therefore have not been considered here.

The *cecum* was found in the fossa iliaca in only about 21 per cent of the cases, in the rest it was in a lower position, i.e., on the linea terminalis in 52 per cent, and in the pelvis minor in 27 per cent of the cases. The *ascending colon* was of average length in 56 per cent of the cases, in 30 per cent it was longer and in 14 per cent it was shorter. The *flexura coli dextra* formed an approximately right angle in only about 10 per cent of the cases, in the others it was an acute angle and the first portion of the transverse colon lay parallel with the ascending colon: in 38 per cent for less or half of the length, in about 29 per cent for more than half of the length of the ascending colon. In about 61 per cent of the cases the hepatic flexure was situated at the level of the fourth lumbar vertebra, in 24 per cent it was above this level and in about 15 per cent below it.

* The sigmoid has frequently been observed on the right side. Ljubomudroff (1926) mentioned Winslow (1752), Fleischmann (1815), Meckel (1820) to have known of this condition and Huguier to have found the sigmoid so often in the right iliac fossa in children that he suggested as early as 1858 that the anus praeternaturalis should be made on the right side if to be performed on a child. The position of the sigmoid on the right, due to the condition described above, however, is very rare if indeed ever described before.

The *transverse colon* was caudo-convex in all but 2 cases, its course was regular in all but 18 cases (12 per cent). In all but 3 cases the transverse colon was found at a lower level than the greater curvature of the stomach. In about 71 per cent of the cases the most dependent portion of the transverse colon reached below the level of the promontorium. Of the remaining 43 cases (about 29 per cent), in which the transverse colon was located above the level of the promontorium, 32 were male (about 43 per cent of the males) and only 9 were females (12 per cent of the females). The lowest point of the *greater curvature of the stomach* reached lower than the level of the third lumbar vertebra in 94 per cent of the cases. It was found in about 25 per cent of the cases at the level of the fourth, in 42 per cent at the level of the fifth and in 27 per cent below the level of the promonotorium. The greater curvature of the stomach was found, as an average, to reach one vertebra lower in females than in males.

The *flexura coli sinistra* was located in 40 per cent of the cases at the level of the third lumbar vertebra, in 28 per cent above this and in 20 per cent below. In the remaining 12 per cent it was not properly outlined. The *descending colon* and the *sigmoid* were empty at the time of observation in most of the cases.

An attempt was made to correlate findings in the abdomen, obtained on the living by roentgenological methods, with data collected in previous studies, by one of the writers, on a large number of cadavers.

Adhesions between the ascending and the transverse colon and between the transverse and the descending colon were frequently noted at autopsies. Their occasional occurrence in older fetuses and babies have suggested that the malfusion took place during the intrauterine life. In the present series adhesions were inferred between the ascending and the transverse colon in 84 cases (56 per cent), between the transverse and the descending colon in 55 cases (or about 42 per cent of the 132 cases in which the splenic flexure was properly outlined). The frequency of their occurrence has suggested that their clinical significance had probably been somewhat overestimated.

The influence of the presence or absence of the gastrocolic portion of the greater omentum upon the shape and position of the transverse colon and upon its relation to the stomach was first noted at autopsies. There, the transverse colon was always found close and parallel to the greater curvature of the stomach, whenever the layers of the greater omentum were fused as far as the taenia omentalis. If, however, this fusion were not present, the distance between the stomach and the transverse colon was found greater than usual, i.e., in such cases where the transverse colon was found lower down (coloptosis) and the stomach higher up in the abdominal cavity with greater space between, the presence of a deep recessus inferior bursae omentalis and absence of fusion of the layers of the greater omentum could always be demonstrated in the cadaver. From these autopsy findings it was safe to conclude that a perfect fusion, a non-fusion, an imperfect or irregular fusion of the layers of the greater omentum may be judged on the living by the relative position of the transverse colon to the stomach as seen during roentgenoscopic examinations and found by palpation and on roentgenograms. Thus (1) a *perfect fusion* was inferred in 44 per cent (two-thirds of which were in males); (2) *non-fusion*, i.e., an absence of the gastrocolic ligament in about 33 per cent; (3) *imperfect fusion* in about 15 per cent, and (4) an *irregular fusion* in 6 per cent; the 3 cases (2 per cent) in which the greater curvature of the stomach was seen below the transverse colon are not included in these figures.

SUMMARY

Roentgen-anatomical studies on the colons of patients with pulmonary tuberculosis are reported. The data given refer especially to the skeletal position of the cecum, length and shape of the ascending colon, shape and skeletal position of the hepatic flexure, transverse colon, splenic flexure, descending colon and sigmoid, and also the skeletal position of the greater curvature of the stomach. Findings in 150 cases, 75 males and 75 females, are presented and some of the differences noted in the two sexes are pointed out: e.g., the transverse

colon was located above the level of the promontorium in 45 per cent of the males and in only 12 per cent of the females; the greater curvature of the stomach was found as an average to reach one vertebra lower in females than in males.

Perfect fusion, non-fusion, imperfect or irregular fusion of the layers of the greater omentum may be judged on the living by the relative position of the transverse colon to the stomach as seen during roentgenoscopic examination and found by palpation and on roentgenograms. (1) A *perfect fusion* was inferred in 44 per cent; (2) *non-fusion*, that is an absence of the so-called gastrocolic ligament, in about 33 per cent; (3) *imperfect fusion* in about 15 per cent, and (4) an *irregular fusion* in 6 per cent. In the remaining 2 per cent of the cases the greater curvature of the stomach was seen below the transverse colon. Adhesions between the ascending and the transverse colon were inferred in 56 per cent, between the transverse and the descending colon in about 42 per cent of the 132 cases in which the splenic flexure was properly outlined.

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EDITORIALS

WILLIAM MERRICK SWEET

DR. William Merrick Sweet was born in Philadelphia, Pa., on June 4, 1860 and died of pneumonia at his home in that city on December 24, 1926.

Educated in the Philadelphia public schools, Dr. Sweet received his medical degree from Jefferson Medical College in 1886.

William Merrick Sweet.

After an internship in Jefferson Hospital and nearly a year of study and travel in Europe, he began the practice of ophthalmology in Philadelphia. Formerly professor of ophthalmology at the Polyclinic, he was, at the time of his death, professor of ophthalmology in Jefferson Medical College and consulting surgeon to the Wills Eye Hospital.

He served successively as secretary and president of the American Ophthalmological Society and he also served, in the same offices, the Section of Ophthalmology of the College of Physicians and was a member of the American Academy of Ophthalmology. He was, for several years, a columnist of the *Philadelphia Record* and, until his death, a member of the Pen and Pencil Club and of the Art Club.

Dr. Sweet was an active and important member of the little group whose work culminated in the organization of the Philadelphia Roentgen Ray Society; but his important relation to roentgenology dates from his description of a method for "The Determination of the Situation of Foreign Bodies in the Eye by Means of Röentgen Rays" at a meeting of the Section in Ophthalmology of the College of Physicians of Philadelphia held on March 16, 1897, and reported in the *New York Medical Journal*, 1897, lxv, 542. This was a description of the little device which preceded the now widely known types of "The Sweet Eye Localizer. A second report entitled "Improved Apparatus for Localizing Foreign Bodies in the Eye Ball by the Roentgen Rays" appeared in *Archives of the Roentgen Ray*, 1909, xiv, 170. This described the more elaborate apparatus familiar to present-day roentgenologists. For his own personal work, however, Dr. Sweet continued to use the original model of 1897, preferring its painstaking calculation to the charted short cut of the later model.

After the second contribution, Dr. Sweet's interest in roentgenology was quite over-shadowed by his increasing interest in ophthalmology and he voluntarily severed his connection with roentgen-ray societies several years ago.

Rather reserved in manner, Dr. Sweet was, nevertheless, among those who knew him well, a cheerful, witty optimist whose absence from his accustomed circles will be sadly noted.

THE RELATION OF ROENTGENOLOGY TO UROLOGY

There is no other special field in medicine to which roentgenology has become so essential as that of urology. Since the advent of the roentgen ray there has been a constant improvement in methods and technique until at the present time roentgenology is almost indispensable in this field.

The first roentgenographic method to be developed, which is still one of the most important aids in the diagnosis of lesions in the urinary tract, was the stereoscopic roentgenogram of the kidney, ureter, and bladder, whereby calculi may be found and their location determined in at least 90 per cent of the cases. By this means also the size, shape and position of the kidney may be determined.

In many cases the primary roentgenogram of the kidney proves to be the *entrée* to a complete roentgenological survey, which results in the definite determination of some pathological condition such as a ptosed kidney, a polycystic kidney, hydronephrosis, an anomalous kidney, or a tumor of the kidney. It is possible also to determine in many instances that palpable masses are not connected with the kidney, as in the case of a Riedel's lobe of the liver.

While a detailed discussion of the differential diagnosis of kidney lesions cannot properly be included in this editorial, mention should be made of the importance of bearing in mind that a large kidney may be only compensatory for a small pathological organ on the opposite side—a comment which indicates the importance of bilateral films. Moreover, the essential importance of stereoscopic films should be emphasized, as only by this means can the plane on which suspicious shadows lie be determined.

Following the roentgenographic survey, pyelography is perhaps the next most valuable aid in the diagnosis of lesions in the urinary tract. Braasch's book on this subject has perhaps given the most valuable aid in this field to roentgenologists. The pyelogram may reveal a stone in the kidney which was not previously seen because it is of the same density as the kidney and appears on the pyelogram as a negative shadow; it may also reveal the first stages of changes in the kidney pelvis and its calyces which are being produced by intermittent or continuous pressure. These changes will be evidenced by dilatation of the calyces or by obliteration of the minor calyces, while the pelvis may or may not be dilated. Usually an extrarenal pelvis is very easily dilated, while an intrarenal pelvis may withstand considerable pressure without showing much dilatation. The pyelogram is almost the only means by which may be determined the presence of anomalies of the kidney such as a bifid pelvis or a horseshoe kidney.

In a case of pyelonephritis the infection of a kidney may be determined from the presence of clubbing of the calyces with some accompanying dilatation; while in pyonephritis the pelvis is usually fragmented and shows isolated abscess cavities. In the case of perinephritic abscess a fistulous tract may be found connecting the kidney pelvis or the ureter with the abscess.

The presence of multiple soft calcific areas in a kidney often indicates a tuberculous infection. In these cases a pyelogram will often show definite fringe-like irregularities of the pelvis and calyces with other evidence of infection, these findings often making it possible to determine definitely the presence of tuberculosis.

Tumors of the kidney are usually identified on the pyelogram by the presence of characteristic deformities; and usually their location in the kidney can be determined. Not only the location, but also in many cases the cause of a single dilated calyx may be identified by a pyelogram. A rather light solution—3 or 4 per cent—of the pyelographic medium may be utilized to determine whether a dense stone in the kidney is located in the pelvis or in a calyx.

Ureterograms are of especial value in the roentgenological study of the ureters and of the pelves. By this means anomalies of the ureters, dilatation, stones and strictures may be identified. There has been much difference of opinion about ureteral stricture. For ourselves, believing that in a great majority of cases the usual ureterogram does not determine the presence of a stricture, we have developed a technique

which we have found to be very satisfactory. This consists in taking a series of films while the ureter is distended by a solution of sodium iodid. These roentgenograms are taken some days after the original pyelographic study has been made, to give time for the disappearance of the irritation and consequent spasm of the ureter which is usually incident to the passing and withdrawing of the catheter. The catheter for this latter examination is passed only a short distance into the lower end of the ureter. The same principle is applied in the interpretation of these films as in the interpretation of successive roentgenograms of the duodenum, that is, the presence of a constant defect on all films is considered evidence of a pathological lesion at the indicated location.

Many lesions of the bladder may be directly identified by cystoscopic examination. The cystogram, however, is of value here also, as it reveals the size, shape and location of a diverticulum and shows trabeculation of the wall of the bladder and irregularities of its outline.

Recently Kohnstam and Cave have given us a valuable little book on the roentgenological examination of the male urethra, in which they show how lipiodol or some other opaque oil preparation may be floated on an almost completely filled bladder, with the patient in the Trendelenburg position, thus delineating the floor of the bladder. By this means the size and shape of the prostate may be shown or a tumor of the floor of the bladder may be identified. They also make interesting urethrograms by which the presence of stricture, of dilatation, and of fistulous tracts connected with the urethra may be identified. Their work is to be commended highly.

For cases in which the injection of the pyelographic medium is impossible or inadvisable, as in the case of a closed hydronephrosis, the method proposed by Rowntree may be used with success. Taking advantage of the fact that sodium iodid is normally excreted in the urine, he has found that following either the intravenous or the oral administration of sodium iodid, excellent shadows of the bladder may be obtained; and in some cases the renal pelves, the ureters, and occasionally even the kidney itself may be seen. He states that the intravenous route is preferable when pictures of the kidneys or ureters are desired, the oral route giving satisfactory roentgenograms of the bladder.

This briefly sums up the present status of the relation of roentgenology to urology.

B. H. NICHOLS, M.D.

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SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-eighth annual meeting, Montreal, Can., Sept. 20–23, 1927.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Washington, D. C., May 16–20, 1927.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. E. C. Samuel, New Orleans, La.
Annual meeting, Memphis, Tenn., Nov. 14–17, 1927.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. A. Arens, Michael Reese Hospital
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. W. W. Belden, 8 West 16th St.
Meets monthly on second Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.
Meets April 25, 1927, at the Orndorff Hotel, El Paso, Texas, for the one day only.

British Empire

BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.
Meets at Dunedin, New Zealand, during February, 1927.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prag, II/52.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

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Secretary, Professor M. Ponzio, University of Torino, Torino.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Fifth Annual Meeting in Kiev, Ukraine, May, 1927.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and S. A. Novotelnow.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Meets in Copenhagen.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

NEW ENGLAND ROENTGEN RAY SOCIETY

The second meeting of the New England Roentgen Ray Society for the year 1926–27 was held at the Boston Medical Library on November 19, 1926.

After a short business session Dr. Cook introduced Dr. William H. Stewart of New York City who presented a paper on "Some Interesting Observations on the Reliability of the Oral Method of Cholecystography." His paper was very much the same as that printed in the American Journal of Roentgenology in the September, 1926, issue. He made the statement that with strict attention to detail and technique, including a re-examination if necessary, the oral method would be just as reliable as the intravenous method of cholecystography and much more suitable for routine office procedure.

His paper was discussed by Dr. L. R. Whitaker of Boston as follows:

At the Peter Bent Brigham Hospital we have been interested in the oral method of cholecystography ever since it was first noticed that reabsorption of the salt after the intravenous method produced a shadow, and some of our house officers drank the raw solution of sodium tetraiodophenolphthalein in the beginning of the development of the test. Realizing its obvious advantages we have done what we could to perfect the method. We have tried several preparations, the most satisfactory of which has been that of Davies, Rose and Co. However, from our experience of 600 cases by the oral method and 400 by the intravenous, we feel no hesitation in making the definite statement that the intravenous method is more reliable. The oral method is of great value in ruling out numerous normal gall-bladders, but in cases of doubt, before subjecting the patient to an operation, we always confirm the diagnosis by the intravenous method.

There is one obvious disadvantage with the oral method which will never be completely overcome as long as sodium tetraiodophenolphthalein is used—the salt is a gastrointestinal irritant. All possible measures should be taken to obviate this effect. The gastric mucosa should be protected from the chemical. If anyone doubts this let him take some of the salt in plain capsules or drink some of the solution on an empty stomach. There should also be some food in the intestine to protect the mucosa. In spite of these precautions, and no matter what method is used, a certain number of reactions will be obtained, though never severe enough to be serious.

I would like to re-emphasize Dr. Stewart's exhortation that the technique must be good and the interpretation skillful. Many results have been marked as failures because the shadow was behind the spine, or the patient had breathed, or the roentgenologist did not recognize the shadow when he saw it. The interpretation of mottling must be guarded; the duodenum usually overlaps the mesial border and the colon the lower border of the shadow, consequently mottling in the upper and outer part of the shadow is most significant.

One of the most important diagnostic criteria, after those originally set forth by Graham and Cole, was developed at the Peter Bent Brigham Hospital. In the very first subject in which the test was tried Drs. Milliken, Sosman, and I noticed a marked reduction of the shadow after a meal rich in fat, and from that time we have used and advocated that procedure as a test for functional activity of the gall-bladder. I have shown by the observation of cats with gall-bladders previously filled with iodized oil at laparotomy, that the smooth muscle of the viscus is the expulsive agent. If in a patient then, the shadow is markedly reduced in size after a fat meal, we know that the musculature is active. This may be true even in the presence of stones. It has been our custom to make films one hour after the meal, but they should be made two hours, and even three hours afterward. If we see a moderate shrinkage of the shadow at the end of an hour we know that the musculature is active, but we do not know that the gall-bladder is not partly filled with stones or débris. But if we see it shrink down to one-tenth or one-twentieth of its original size in two or three hours, or if it disappears within that time, we are almost certain it is normal.

There is one interesting deduction that can be drawn from the fact that emptying is produced by muscular activity. If we get a good shadow of the gall-bladder we are sure that the musculature is functioning; if we get even a faint shadow we are sure it is active to some degree. Because if the wall of the gall-bladder were sclerotic enough to prevent muscular activity the viscus could not empty. Consequently it would remain full of whatever it happened to contain at the time—stones, or mucus, or débris—and could not refill with the dye.

But there is one caution that must be observed with regard to these deductions from filling and emptying. I have found that with animals in poor condition the musculature is inhibited and there may be no emptying after a fat meal. It is conceivable that in patients with gastrointestinal disturbances or in those suffering from debilitating disease, the gall-bladder may, from previous failure to empty, be distended with concentrated bile at the time the test is done, and no shadow obtained, even though the organ is normal. Incidentally it seems to me that stasis thus produced is an important factor in the etiology of gallstones. I have produced stones in animals by simply altering the mechanism in such a manner that the gall-bladder did not normally fill and empty. The important diagnostic criteria for cholecystography, then, are:

1. (*a*) The filling of the gall-bladder, indicating an active musculature; or

(*b*) the failure to fill, indicating blockage of the duct, or lack of normal emptying from destruction of the musculature.

2. The gradual reduction and disappearance of the shadow within two to three hours indicating an active musculature, and the absence of débris.

3. Mottling, if definite, indicating stones.

Dr. Frank Lahey discussed Dr. Stewart's paper from the standpoint of the surgeon and stated that it was not fair to decide to operate on a patient from a single test such as cholecystography, but that the decision should be made by the surgeon with due consideration of all the factors and information available. He said further that if operation were decided upon, it was better to remove the gall-bladder than to do a cholecystostomy. The figures from the Deaconess Hospital, as collected by Drs. I. P. Bogart and L. B. Morrison, showed that the preoperative diagnosis from the cholecystograms was correct in 78 per cent of those having the intravenous method with 29 per cent reaction, as compared with 90 per cent correct interpretations by the oral method with 39 per cent reactions.

Dr. John Sproull of Haverhill reported a method he had been using whereby he fed the patient 2.5 gm. of the dye mixed with six tablespoons of cream-of-wheat. This was given in place of the evening meal and the patient reported as usual the following morning without breakfast, for roentgen examination. Of 23 patients examined by this method good shadows of the gall-bladder were obtained in 21. Three patients had nausea, 2 vomited, and 2 had diarrhea.

Dr. Chester Jones of the Massachusetts General Hospital reported that in one case a normal shadow had been obtained in a patient with a markedly diseased gall-bladder, and said that in several cases of duodenal ulcer no gall-bladder shadows had been secured. Furthermore, cases of hepatitis or other liver in volvement might fail to give a normal cholecystogram which would be misleading and he suggested cholecystographic studies of patients with chronic passive congeston to determine their liver function.

Dr. Ralph D. Leonard in his discussion stated that cholecystography should not be used as the sole roentgen examination of the gall-bladder, but that it should supplement the indirect method as advocated by George and Leonard, and that all patients should have a barium gastrointestinal examination.

Dr. John H. Lambert of Lowell in his discussion stated that the greatest caution should be used in reporting cholecystitis or a normal gall-bladder as evidence for or against operation, as in his opinion, cholecystography was a test of function, and did not decide the presence or absence of a pathological process in the gall-bladder.

Dr. Stewart, in closing, answered several questions from the floor and stated that most of the information on which he based his work was obtained from Boston institutions, and that he appreciated the privilege and honor of appearing before a Society which had done so much to further the knowledge of this particular subject.

The third meeting of the New England Roentgen Ray Society for the year 1926–27 was held at the Boston Medical Library on December 17, 1926.

After the usual business session and a short report by the secretary on the Twelfth Annual Meeting of the Radiological Society in Milwaukee, the Society proceeded to a symposium on the Gastrointestinal Tract, the speakers being Dr. A. S. McMillan of the Massachusetts Eye and Ear Infirmary, Dr. John D. Camp of the Massachusetts General Hospital X-ray Department, and Dr. David Cheever, Assistant Surgeon at the Peter Bent Brigham Hospital.

1. Dr. A. S. McMillan gave a résumé of 455 esophagus cases examined by the roentgen ray at the Eye and Ear Infirmary, all of the cases presenting themselves with a history of dysphagia. In his preliminary remarks he advocated the use of a thick paste of barium sulphate and water, made up as thick as possible. To this he adds powdered gum arabic which liquefies the mixture and allows the addition of more barium. He then discussed the various lesions found in these 455 cases of which only 155 were negative. Sixty per cent of the lesions were found in the esophagus above the episternal notch, and the frequency is indicated by the following table.

	CA	F.B.	Non CA	Ext. Pres.
Upper third Above episternal notch	45	59	45	10
Middle third	39	0	4	1
Lower third	24	4	44	0

	Burns	Paralysis	Pouch
Upper third Above episternal notch	2	7	6
Middle third	6	0	2
Lower third	1	0	0

Dr. McMillan then discussed the special diagnostic points of such lesions as bulbar paralysis, paralysis of the tongue, webs, ulcers, spasms, fistulae (usually due to carcinoma), traction diverticula (which he said were usually due to adhesions from an old mediastinal tuberculosis), and external pressure such as aneurysm or tumors.

2. Dr. John D. Camp continued the symposium on gastrointestinal lesions by discussing the errors of commission and omission in the diagnosis of gastric and duodenal ulcers. The most common errors in his experience were (*a*) missing small ulcers; (*b*) overlooking ulcers on the pos-

terior wall of the stomach; (*c*) mistaking carcinoma for ulcer, and vice versa, and (*d*) diagnosing an ulcer when none was found at operation. In the avoidance of these errors he stressed the value of watching the first swallow of barium entering the stomach and of palpation with only a little barium in the stomach, mentioning particularly small defects, craters or distortion of the rugae. He called attention to the "halo effect" and the "meniscus deformity" reported by Carman. He noted that "fleck" ulcers of the duodenum were commonly overlooked as the bulb might not be deformed, and suggested that the crater in these ulcers could also be demonstrated by palpation. In regard to the healing of ulcers he stated that the deformity of the bulb rarely disappeared even when the patient was symptom-free, but that gastric ulcer did disappear. This might be erroneously interpreted, due to food, mucus or blood in the crater of the ulcer.

3. Dr. David Cheever of the Peter Bent Brigham Hospital spoke on the diagnosis, prognosis and treatment of gastric carcinoma, paying a compliment to the roentgenologist by saying that the roentgen ray was becoming an instrument of precision. He said that carcinoma of the stomach forms one-third of all intra-abdominal carcinomas, and that there was an unjustifiable pessimism in relation to its treatment, as all carcinomas of the stomach must in the beginning be local and therefore operable. This is borne out by the findings in 20 per cent of the 89 cases operated on or coming to autopsy which had no metastases in the liver, and by the fact that 70 per cent of all gastric carcinomas occur in the distal third of the stomach. He mentioned the frequency in which the symptoms are either absent or minor and stated that in 20 per cent of the 236 cases the first symptoms were not referable to the gastrointestinal tract. The diagnosis, however, is practically limited to roentgen examination. It was found to be by far the most reliable method in this series of cases, as it gave a correct diagnosis in 93 per cent and a suggestive one in 3.5 per cent and was negative in only 3.5 per cent, so that it is possible to make the diagnosis accurately in 97.0 per cent of the cases.

In the matter of treatment it was found that the radical operation could be done in only 9.7 per cent of the cases and 62.6 per cent were inoperable from the standpoint of either palliation or cure. In the 9.7 per cent of radical operations there were 13 per cent of the patients living five years without evidence of recurrence, equivalent to 1.2 per cent of all cases with carcinoma of the stomach. In conclusion, he urged that the pessimistic viewpoint be abandoned and that attempts be made to bring the patient to the surgeon in the operable stage.

The papers of Drs. McMillan, Camp and Cheever were discussed by Dr. O'Brien Dr. White, Dr. Lambert, Dr. Holmes, Dr. Gerber, Dr. Wheatley, and Dr. Sparks of St. Bartholomews Hospital in London.

M. C. Sosman,
Secretary.

VIENNA LETTER

(From our special correspondent)

THE FIGHT AGAINST CANCER

At a recent meeting of the Austrian Roentgen Society, Professor Guido Holzknecht delivered a lecture on the importance of Warburg's researches on roentgen-ray therapy. He said that the discovery of Warburg, a Berlin chemist, that animal cancers nourish themselves on the grape sugar content of the blood is supplemented by the work of Drs. Rona and Deutsch who found that the same holds true in human beings. This discovery, published only about a year ago, seemed to prove that cancer is dependent upon the supply of grape sugar and that it cannot grow in the absence of it. This seemed to offer a new method of therapy. We are still, however, far from any assurance that simply depriving cancer of an adequate supply of grape sugar would be of value in treatment since grape sugar is needed by the normal cells of the body as well. The experiments of Dr. Silberstein of Vienna who tried to diminish the grape sugar content of the blood by the generous

administration of insulin though seeming in some cases to delay the growth of the tumor did not, on the whole, prove very reassuring. Cancer is able to draw a sufficient amount of sugar even from sugar-poor blood.

Dr. E. G. Mayer, a Vienna roentgenologist, approached the problem in a different way. Recognizing the fact that desaccharization of the blood through the administration of insulin does more harm to the organism than cancer itself Mayer injected into the body very large quantities of sugar. This excess supply of nourishment apparently causes an extraordinary change in the cancer, possibly a sudden, brief, super-metabolism. In this condition cancer displays a very marked decrease in resistance to the influence of roentgen rays and radium. Several experimental cancer cases treated by irradiation after injection of an abundant supply of sugar showed definite evidence of improvement. It would be an exaggeration to say that this method is apt to cure cancer, but it may be stated quite certainly that the action of the roentgen rays is considerably enhanced by the preliminary injection of grape sugar. Only the future will show whether or not this method will prove really efficacious in the fight against cancer. The work has been confirmed however, by other roentgenologists of Vienna, Berlin and Breslau, and Frik in Berlin recently reported that animal cancers irradiated after the injection of sugar not only diminished more rapidly than those treated by irradiation alone but the animals excreted more lactic acid, a proof that the development metabolism of cancer was interfered with.

PHOTOGRAPHING THE INSIDE OF THE STOMACH IN THE LIVING

In the clinic of Professor Wenebach in Vienna extensive experiments are being made with a novel method which was reported on by Professor Elsner of Berlin at the Congress on Metabolic Diseases held in October, 1926. The method consists in the introduction of a rigid tube into the stomach with a tiny photographic camera attached to its end. The appliance contains seven films which by an ingenious mechanism are displaced one behind the other within the tube. The photographs are instantaneous ones and give a true image of the inside of the stomach. Professor Wenebach is quite satisfied with the results achieved up to now, although he states that the method still requires perfection.

HOT POULTICES FOR ROENTGEN ULCERS

Dr. Veiel of Cannstadt succeeded in curing permanently three serious roentgen ulcers by the persistent application of hot poultices in the relatively short period of two to four months, with a satisfactory final result from the cosmetic point of view. If we bear in mind the difficulty of curing many roentgen ulcers even after radical excision and skin transplantation the treatment certainly deserves a trial. The technique is very simple consisting simply in the application of a fresh poultice each morning.

THE TREATMENT OF CANCER WITH "LIQUID LIGHT"

Dr. Paul Lazarus, professor at the University of Berlin, reported recently on a new method of radiotherapy to be used in the treatment of cancer and other malignant tumors and certain skin and blood diseases. The method consists in applying radioactive substances in solution. Any improvement in the treatment of cancer seems very important in Germany where the disease is very prevalent. The latest statistics show that while 10.3 out of 10,000 inhabitants died of consumption the proportion of those who succumbed to cancer was 10.8. During the past year 67,000 persons died of cancer against 63,000 from tuberculosis. The so-called "liquid light" is nothing else than thorium obtained from monacit sand, a volcanic eruption stone occurring mainly in Brazil. A solution of the thorium x supplemented with oxide of zinc gives a greenish light in the darkness. It is used as a complementary method of treatment to roentgen and radium therapy. The preparation loses one-half its strength in half an hour while radium loses half its strength only after the lapse of 1800 years. The preparation in competent hands is without danger. The dose must be care-

fully established in each individual case. The liquid is injected drop by drop into the tumor mass and exerts a destructive effect upon the tumor. The subsequent application of the roentgen ray greatly enhances the destructive effect. Experiments with the method are still under way and it is too early to make any definite statements with regard to the ultimate results to be obtained by this method of treatment.

THE CALCULATION OF THE ROENTGEN RAY SKIN DOSE

(A CRITICISM OF THE FORMULA METHOD OF ROENTGEN RAY DOSE CALCULATION)

To the Editor:

In view of continued inquiries pertaining to certain misconceptions regarding the use of arithmetic dosage formulae for the calculation of the roentgen dose, when using a given spark gap, milliamperage and filter, we feel that a further word on the limits of the practical use of such dosage formulae is not amiss.

It would appear at this late date that no further discussion on the matter should be required, especially since men of repute have shown the fallacy of employing some of the present day formulae. Shearer in a criticism published in this Journal for March, 1921 restates the fundamental physical laws, with which many individuals take unjustifiable liberties. Included in his many critical remarks appears one as follows: "To base dosage on a method that is so much at variance with well established physical laws, and giving readings inconsistent among themselves, requiring such a vast amount of useless arithmetic, can only lead to confusion." Also in another article, published in this Journal for August, 1922, he states, that "familiarity with the physical laws underlying the subject should protect him (the roentgenologist) from publishing irrational papers or accepting these from others." Unfortunately in this country the formula method of dose calculation has received such wide publicity that men lacking fundamental knowledge of the subject have employed the method with uncertain if not deleterious results. Outside of the United States the formula method of dose calculation is neither recognized nor understood. Jüngling in his book "Roentgenbehandlung chirurgischer Krankheiten, Hirzel, Leipzig, 1924" referring to the matter of dose calculation as propounded in America states that the method is incomprehensible and impossible of reproduction.

In this letter we will limit our remarks to the frequent misapplication of fundamental physical laws, leaving for later consideration the practicability of dosage measurement by means of arithmetic formulae.

The formula method mostly used for the calculation of dosage in roentgen therapy is described in a large number of publications as well as in "X-Ray Dosage in Treatment and Radiography," by Witherbee and Remer, Macmillan, New York, 1923, and "X-Ray and Radium in the Treatment of Diseases of the Skin," by MacKee, published by Lea and Febiger, Philadelphia, 1921. In these publications we find among others the following faulty statements, which never have been retracted:

(1) In the formula for calculating the dose when using unfiltered rays, these authors state that intensity varies directly as the voltage.

(2) In the formula for calculating the dose when using filtered rays, they again state not only that the intensity varies directly as the voltage, but also upset the inverse square law by the statement that intensity varies inversely as the distance—both contrary to established facts.

Shearer in the first mentioned article called attention to the fact that these statements are contradictory to well-established physical laws. Experiments carried on by a number of investigators since Shearer's publications show the truth of his conclusions. There is no doubt that the surface intensity decreases with the square of the distance and increases almost exactly as the square of the spark gap. That small variations with regard to the inverse square law can be found by actual measurement at different focal distances is ascribable to scattered and stem radiation as well as to

different sizes of the focal spot. The influence of these factors is, however, by no means sufficient to permit digression from the inverse square law. Furthermore these variations occur mainly when dealing with very short focal distances.

The reason that no more damage has occurred as the result of dose calculation by the erroneous formula method is that the original calculations were based on short focal distances and that the dosage actually delivered at increased focal distances is relatively much less than calculated.

With regard to the change of the formula from voltage squared to calculation in the first power it must be admitted, especially when using filtered rays, that biological reaction does not appear to obey the voltage square law, whereas physically measured the voltage square law holds practically true. The difference between the physically and biologically measured dosages must depend upon absorption, which varies according to the quality or wave length employed. The differences in biological reactions present a far more complicated problem dependent entirely upon ray quality, with which no parallelism between the voltage calculated in the first power and the actual reaction has been established. In regard to this latter question permit us to refer again to the above-mentioned articles as well as to our recent publications on this matter (*Radiology*, April, 1926; AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY, July, 1926; *Strablentherapie*, 1925–26, xx, xxi, xxiii).

In view of the foregoing any formula for the calculation of roentgen dosage must begin with correct physical data. However it should be remembered that while in the formula

$$\frac{A \times V^2 \times T}{D^2} = I$$

A represents in actuality the directly measured quantity of roentgen rays, this not always in definite relation to the milliamperage, and V should be supplemented by the definite measurement of the actual quality of the ray since the spark gap method has been proven too inaccurate in reproducing quality readings on different installations.

WM. H. MEYER, M.D., and
OTTO GLASSER, PH.D.

Detroit, Mich.
December, 13, 1926

Dr. D. R. Bowen,
Philadelphia, Penna.
Dear Dr. Bowen:

In the November, 1926, issue of the AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY under the Department of Technique is an article dealing with misinterpretation of Sweet localizations. The point brought out is one on which too much stress cannot be laid, but I feel that mention should be made of Dr. James G. Van Zwaluwenburg, who in his article "Greater Certainty in the Localization of Foreign Bodies in the Eye," published in the October, 1917 issue of this Journal brought out all the practical applications of this principle together with the theoretical discussion.

Very truly yours,
C. S. DAVENPORT, M.D.

(Dr. Davenport's criticism is well taken, but our error is not wholly without compensating features, in that it recalls attention to Van Zwaluwenburg's article. It is doubtless true, that many earnest readers discouraged by the theoretical discussion so carefully worked out in this article, have failed to read through to the brief but lucid, practical application with which it ends.)

D. R. B.

$100,000 OFFERED FOR CONQUEST OF CANCER

Two prizes of $50,000 each have been offered by William Lawrence Saunders of New York for discoveries of the causation, prevention and cure of cancer. The offer was made on December 15, 1926, and will stand for three years. The donor expects to renew it, if necessary.

Mr. Saunders is Chairman of the Board of Directors of the Ingersoll-Rand Company, Director of the Federal Reserve Bank of New York and President of the United Engineering Company.

The decision upon which the awards will be made is to be reached by the American Society for the Control of Cancer and approved by the American Medical Association and the American College of Surgeons.

It is Mr. Saunders' idea that discoveries are not always made by experts and that "through the lure of a reward this serious problem might be solved through the genius of a lay mind, by chemists or through unorganized medical sources."

The offer of Mr. Saunders to the American Society for the Control of Cancer has not yet been formally acted upon by the Society, and it is impossible to say at this time what rules other than those proposed by Mr. Saunders will control the decisions. Information as to how persons who wish to present their discoveries for consideration should proceed will be announced later.

Mr. Saunders made his offer known through a letter to Dr. C. N. B. Camac of New York under date of December 13, 1926, and read by Dr. Camac at a dinner given in the interests of the American Society for the Control of Cancer by President Nicholas Murray Butler of Columbia University and Honorable Charles Evans Hughes.

The letter follows:

New York,
December 13, 1926

Dr. C. N. B. Camac,
76 East 56th Street
New York.

Dear Dr. Camac:

I regret that because of a previous engagement, which I cannot well forego, I shall be unable to accept your kind invitation to be present at the dinner on the 15th inst in the interest of the American Society for the Control of Cancer.

May I ask you to represent me on this occasion by making the following statement?

I will give Fifty Thousand Dollars ($50,000) to any person or group of persons who may discover what human cancer is and how it can positively be prevented.

I will give Fifty Thousand Dollars ($50,000) to any person or group of persons who may discover an absolute cure for human cancer.

The entire sum; that is, One Hundred Thousand Dollars ($100,000) may be given to the same person or group of persons.

The decision upon which these awards shall be made is to be determined by the American Society for the Control of Cancer and approved by the American Medical Association and the American College of Surgeons.

This proposition shall expire at the end of three (3) years from the date of this letter, unless it is further extended by me. This I hope and expect to do.

What I have in mind is this: Discoveries are not always made by experts. Physicians, like business men, are not always the best research workers. Through the lure of a reward this serious problem might be solved through the genius of a lay mind, by chemists or through unknown and unorganized medical sources.

Yellow fever, for instance, has been destroyed through the research work of three obscure Army surgeons—Reed, Lazear and Carroll. As far as I know, no cure for yellow fever has been found, nor is a cure necessary so long as we now know how to control and prevent the disease.

This letter gives only the outline of this proposition, the details of which might be drawn up by the American Society for the Control of Cancer, or by such other persons as they may select.

Very truly yours,
(signed) William Lawrence Saunders.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE DUODENAL TUBE AND ITS POSSIBILITIES. By Max Einhorn, M.D., Professor of Medicine at the New York Postgraduate Medical School; Visiting Physician to the Lenox Hill Hospital, New York. Second edition, revised. Cloth. Price, $3.00. Pp. 206, with 126 illustrations. Philadelphia: F. A. Davis Co., 1926.

This little book, now in its second edition, brings together all of Einhorn's work on intubation. Indeed, the title (The Duodenal Tube) is perhaps somewhat inadequate, as the entire alimentary tract, from esophagus to rectum, can now be penetrated from above with one or another type of apparatus calculated to give experimental or diagnostic evidence, or to administer treatment. To be sure, some of the procedures described are now more of historic than of practical import as they antedate the roentgen ray era. Other may well supplement the roentgen ray in the field of diagnosis, and still give independent promise of real experimental value. Of special interest, perhaps, are the intestinal delineator and the intestinal tube. The former consists essentially of fine metal wires enclosed in a small flexible alimentary canal. By this means, new evidence has been obtained as to the nature of the motor transport in the small and large intestines. The intestinal tube, on the other hand, being hollow, permits of the introduction of fluids to any desired level, and possibly—though this is not mentioned by Einhorn—of the withdrawal of secretions for study.

Unfortunately, the excellent presentation of the text is marred by the indistinctness of the reproductions of roentgenograms. These are sufficiently important to encourage the hope that future editions of this book will show a thorough revision in this particular.

JOHN L. KANTOR.

INJURIES OF THE WRIST. By the late Dr. Etienne Destot, Lyons. Translated by F. R. B. Atkinson, M.D., Edinborough University. Cloth. Price, $6.00. Pp. 169, with 87 illustrations. New York: Paul B. Hoeber, Inc., 1926.

Destot's book is unique in that the author has put into his work so much of value and so many facts that are little known or overlooked by the average general or orthopedic surgeon. It is a volume that should be read and kept for reference by both the surgeon and the roentgenologist.

The detailed description of operations on the wrist are excellent and proved of great assistance to this reviewer in two recent cases—one a fracture of the scaphoid, and the other an old dislocation of the semilunar. This book will serve a very useful purpose if it will compel the average physician and surgeon to pay more attention to so-called sprains of the wrist.

It should also impress the roentgenologist with the importance of careful study of the carpus in all cases of Colles' fracture. It is indeed refreshing to find one man so enthusiastic over injuries to one joint, when up to a few years ago fractures and dislocations had to take secondary consideration in the average general hospital.

JOHN A. TALBOT.

DIATHERMY, WITH SPECIAL REFERENCE TO PNEUMONIA. By Harry Eaton Stewart, M.D., Consultant in Physiotherapy, U. S. V. B. Hospital, New Haven, Conn.; Director, New Haven School of Physiotherapy. Second edition. Cloth. Price, $3.00. Pp. 228, with 45 illustrations. New York: Paul B. Hoeber, Inc., 1926.

The first edition was published in 1923 under the title "Diathermy and Its Applications to Pneumonia." The author has made a slight change in the title of the second edition as he deals with diathermy in general, but with special reference to pneumonia.

In the second edition there are more than three times as many case reports as in the first edition and the technique of pulmonary diathermy has been elaborated. The two hundred and twenty-eight pages are divided into seven chapters with forty-five illustrations and fifteen charts. A general introduction is followed by chapters on general diathermy technique, surgical diathermy, detailed case histories, a summary of the total case reports, bronchopneumonia, and conclusions. The technique of general diathermy is explained in detail with an adequate description of apparatus, the physics of diathermy, and the results of experiments to demonstrate the internal heating effect of diathermy.

The greater part of the book is devoted to the treatment of pneumonia, detailed histories

of such cases and the conclusions derived from a study of these cases.

The author makes no exaggerated claims for diathermy in the treatment of pneumonia and the data submitted are conservatively appraised.

The book may be recommended as a guide to those using or about to use diathermy as a therapeutic agent in this disease for which other forms of therapy have proved so inadequate.

FRED O. COE.

BOOKS RECEIVED

APPLIED X-RAYS. By George L. Clark, PH.D., Assistant Professor of Applied Chemical Research, Massachusetts Institute of Technology. Cloth. Price, $4.00. Pp. 255, with 99 illustrations. New York: McGraw-Hill Book Co., Inc., 1927.

A DESCRIPTIVE ATLAS OF VISCERAL RADIOGRAMS. By A. P. Bertwistle, M.B., CH.B., F.R.C.S.ED., Late Resident Surgical Officer, General Infirmary, Leeds, and E. W. H. Shenton, M.R.C.S., L.R.C.P., Late Senior Surgical Radiographer, Guy's Hospital, London. Cloth. Price, $12.50. Pp. 250, with 330 illustrations. St. Louis: C. V. Mosby Co., 1926.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

BELDEN, WEBSTER W. Some x-ray findings in lobar pneumonia. *Radiology*, April, 1926, vi, 329–335.

Every case of lobar pneumonia should be roentgenographed as soon as possible. This is especially true for children and even in some cases in adults with the symptoms of an acute surgical abdomen. Some of these patients have been subjected to a laparotomy whereas if a roentgenogram had been taken the diagnosis of pneumonia would have been established. A negative roentgenogram of the chest in such a case would then mean an intra-abdominal lesion.

The roentgen examination is peculiarly reliable because in the earliest stages of lobar pneumonia encountered clinically, even before physical signs are present, well marked shadows are already to be seen. The earliest sign is a slight accentuation of one hilus shadow and a definite increase in the linear markings. This increase in the markings may be throughout one lung but may be limited to a lobe. The sequence of events will then be the appearance of a hazy, rather thin shadow involving an entire lung or one or more lobes. In twenty-four hours or more this slight haziness becomes more or less opaque and may show the complete configuration of the involved lobe or lung. This process may go on to show a complete dense shadow. Later the diffuse opacity of the shadow becomes less and there is more or less mottling by areas of increased and decreased density corresponding to resolution. Finally, the only finding which remains is perhaps a faint mottling and accentuation of the linear markings which may persist for a month or more. In judging these signs pulmonary tuberculosis must be kept in mind. The author has reviewed the findings in 357 cases of lobar pneumonia observed at the New York Hospital from 1916 to date. Pneumococcus Type I occurred in 28 per cent of the cases; Type II in 13 per cent; Type III in 4 per cent, and Type IV in 54 per cent. That is, atypical pneumonia was encountered more often than any other and this was borne out by a study of the roentgenograms. The data are tabulated and show that in 110 of the cases of lobar pneumonia in the upper lobe of the right lung pneumococcus Type IV was the causative agent in 78 per cent of the cases. In the right middle lobe Type I was responsible for 43 per cent; Type II for 31 per cent, and Type IV for 20 per cent of the 35 cases. In the lower lobe Types I and II were responsible for about half of the cases and IV for the other half of the 83 cases. A similar picture is shown for the upper and lower lobes of the left lung. The general trend of the figures leads to the suspicion that pneumococcus Type IV is the organism most frequently found in the upper lobes, although the lower lobes of both lungs also show a fairly high percentage of Type IV infections.

The author feels that if consolidation of lobar pneumonia of the upper lobe is detected in the roentgenogram, one is warranted in saying that the causative agent is most probably pneumococcus Type IV and the chances of being correct in this will be 75 per cent.

FORESTIER, JACQUES. Roentgenological exploration of the bronchial tubes with iodized oil (lipiodol) *Radiology*, April, 1926, vi, 303–309.

Roentgenologic exploration after intratracheal injection of lipiodol gives a possibility of securing direct films of normal and pathologic bronchial tubes and of lung cavities. It has been especially helpful in the diagnosis of bronchiectasis. An experience of four years has proven that this technique is quite harmless, and that lipiodol may have some therapeutic value.

The contraindications to the use of lipiodol are: (1) hemoptysis; it is safer to wait a few days after the end of it before making a lipiodol injection; (2) the injection is not to be attempted in febrile tuberculous patients; (3) in cases of pulmonary gangrene or any anaerobic infection of the respiratory tract, it is advisable to avoid any cricothyroid puncture, and if a lipiodol injection is wanted to administer it by the transglottic method.

By means of lipiodol injections deviations of the trachea about which numerous mistakes are made, are easily distinguished from the apex cavities for which they are mistaken on ordinary roentgenograms. The presence of a pulmonary tumor involving a lobe does not allow lipiodol to enter the corresponding bronchi; hence the absence of penetration into a lobe which has been put in good position during the injection is an aid to diagnosis of severe pathologic changes.

In the case of lung compression by thoracic

or pleural growth, the outline of the growth is sharply given by the stoppage of the lipiodol at the periphery of the growth. Cavities of the lung may be exactly localized and their shapes and volumes clearly outlined provided they are in communication with the bronchial tubes. The irregular pictures of tuberculous cavities and those of lung abscesses in pulmonary gangrene are quite characteristic even when all clinical and other roentgenological findings are uncertain.

The most important benefit of the method has been the direct diagnosis of bronchiectasis. In many cases when there were only suspicions, the proof has been furnished of the existence of the disease. In other cases it has permitted the correction of a wrong diagnosis by showing that the bronchial tubes were of normal size. All kinds of bronchiectases may be observed on the films.

After therapeutic pneumothorax, exploration with lipiodol may give two kinds of information: (1) in case of pleural adhesion to show whether it consists of the plain membrane or contains a fragment of the lung; (2) when bronchiectases or tuberculous cavities have been treated by a therapeutic pneumothorax the method is a control of the lung collapse.

Benassi, Enrico. Cholecystography and the function of the gall-bladder. *Radiol. med.*, May, 1926, xii, 339–347.

The author performed experiments on dogs with a view to determining the value of the various procedures which have been recommended recently to render the gall-bladder visible in the roentgenogram. From his first experiments he concludes that it is possible to show the gall-bladder in the roentgenogram. He finds that the substances that give the best results are the sodium salts of tetrabromphenolphthalein and tetraiodophenolphthalein, the latter probably being somewhat preferable, as they render the bile opaque to roentgen rays, are readily soluble and less toxic.

Cholecystography, especially if the roentgenograms are taken in series, is a valuable aid in studying the function of the gall-bladder, because it shows the morphological changes which take place during digestion *in vivo* and under conditions which are perfectly physiological. Roentgen examination shows that the gall-bladder has a physiological capacity for contraction; this capacity is manifested, or at least becomes more visible when chyme passes into the duodenum. At that time there are diffuse contractions of the whole organ, but they are more marked in the dog at the neck of the gall-bladder and it is these contractions which cause the flow of bile into the intestine.

George, A. W. The practical value of the Graham-Cole method in the diagnosis of gall-bladder disease, as compared with the older method. *Radiology*, April, 1926, vi, 292–295.

It does not seem possible to make the normal, healthy gall-bladder visible routinely. The moment pathological change occurs there is usually increased density of the gall-bladder wall. These changes in turn occasion changes in the bile and possibly gallstones all of which cast a shadow on the roentgen film. In addition, there are the secondary signs of gall-bladder pathology to be found in the gastrointestinal tract. It is only by the plate or film method, where the stomach is not disturbed by manipulation that these secondary signs may be brought out with sufficient definiteness. The detection of gallstones by the old method depends entirely upon the technical skill of the operator. The changes in the second portion of the duodenum give valuable evidence. The filling of the ampulla of Vater is a minor sign which in the author's opinion is always a signal that some more definite evidence has possibly been overlooked. If all the other signs are lacking and this filling is present, it is presumptive evidence of biliary tract involvement or pancreatic disease. The change in the hepatic flexure or proximal portion of the transverse colon is another piece of definite evidence in diagnosing gall-bladder disease by the older method. This older method of diagnosis is regarded as an independent one.

On the other hand, the method of diagnosing gall-bladder disease by cholecystography is not an independent method of examination except in the diagnosis of gallstones.

The older method may be supplemented by cholecystography in two points: (1) in confirming the visible shadow of the gall-bladder visualized by the older method, and (2) in making visible by contrast cholesterin-like stones which cannot be detected by the older method.

Fränkel, Arthur. The intrinsic movements of the stomach in the roentgen picture. III. Practical diagnostic results from the roentgen study of gastric peristalsis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, January, 1926, xxxiv, 1–22.

Diagnosis of Gastric Ulcer. Heretofore there was no reliable roentgen symptom of the gastric ulcer without niche. This symptom has been discovered by the roentgen observation of the gastrointestinal movements. It is characterized by a cessation of motion at a distance of 8 mm. from the site of the ulcer on the lesser curvature. This block cuts across the wave of

peristalsis like a cross bar, separating, as it were, the peristalsis from the ulcer, hence the term "cross bar symptom." This sign is not directly diagnostic of the ulcer, but merely signifies a segmentally limited functional alteration of the transverse musculature of the stomach called forth by the ulcer irritation analogous to the isometric, anisotonic contraction of striped muscle.

In contradistinction to the Haudek niche which is primarily symptomatic of an occluded ulcer, the cross bar symptom appears to be characteristic primarily of the (deep) ulcus simplex, i.e., the non-occluded ulcer threatening perforation. Because of this fact the cross bar symptom is an important contribution to the objective indications for operation.

Under favorable circumstances the cross bar symptom is demonstrable on the roentgenoscope when there is present a high degree of "pre-peristalsis" (by "pre-peristalsis" is meant a relative hyper-pre-peristalsis which depends largely on the individuality of the gastrointestinal movement).

Early Diagnosis of Carcinoma. In the stomach suspected of ulcer the cross bar symptom strengthens suspicion to the point of certainty and locates the site of the ulcer. Since this sign is only a linear defect of motility it is not, in contrast to the Haudek niche, absolutely pathognomonic for ulcer in the absence of anatomical configurations typical of ulcer. Precisely the same linear block in motility may be due to carcinoma while the latter is small and the surface smooth. This anatomical deformity may make it possible to give an early diagnosis of carcinoma in certain cases by roentgen study of gastric movements where the ordinary roentgen examination fails. In cases with more pronounced disturbances of gastric motility, the diagnosis of carcinoma can be conveniently made roentgenoscopically even in the absence of the characteristic jagged indentations ordinarily shown by carcinoma.

GOALWIN, HARRY A. The roentgenography of the orbit and petrous pyramid and its clinical value. *J. Ophth., Otol. & Laryngol.*, January, 1926, xxx, 7–30.

The orbits and the petrous pyramids are the most complicated structures of the most complicated part of the human skeleton. The demonstration of each of their component parts on the roentgenogram frequently requires a separate view.

The complete roentgen examination of the orbit requires at least seven different roentgenograms. Of the seven views, three serve for a general survey of the orbit; these are the lateral, axial and posteroanterior. Of the next two views, one serves for the projection of the orbital roof into the area inclosed by the shadow of the orbital margin and the other for a similar projection of the floor and sphenomaxillary fissure. The last two views are for the apex or optic canal; one for its cross section and the other for its profile. The axial and posteroanterior views as well as the roof and floor views can be taken of both orbits simultaneously. The remaining views must be taken of each orbit separately. This makes a total of ten roentgenograms for the complete investigation of both orbits. A consideration of the component parts of the bony orbits and the soft structures that are in relation to each will indicate the clinical value of each of the above roentgenograms.

The roof of the orbit is projected into the orbital margin area by placing the head, face toward the film, so that the median plane is perpendicular to the film, the horizontal plane of the head makes a caudally open angle of 52° in the adult or the appropriate angle, more than 52°, when the patient is under seventeen, and aiming the central ray toward the intersection of the median plane with the line connecting the centers of the two orbital outlets. The roofs of both orbits are thus projected for comparison. The profits of the orbital roof is projected on the roentgenogram in the lateral view.

The orbital floor and the sphenomaxillary fissure are projected on the roentgenogram when the patient's head is placed facing the film so that the median plane is perpendicular to the film and the horizontal plane makes a cranial open angle of 60°, and aiming the central ray toward the intersection of the median plane with the line connecting the centers of the two orbital outlets. This gives a projection of both orbital planes and both sphenomaxillary fissures. The profile of the floor is seen in the lateral view. Excessive pneumatization of the maxillary sinus may produce a bulging of the orbital floor into the orbit and thus push the eyeball forward. This condition can be demonstrated on the posteroanterior and lateral views of the orbit, and the roentgenograms can thus help to differentiate this exophthalmos from that of hyperthyroidism.

The roentgenography of the sphenoidal fissure is of greater value than even that of the sphenomaxillary. Along the upper margin of the former there runs the trochlear nerve, and the frontal and lacrimal branches of the ophthalmic division of the trigeminal nerve enter the orbit; and along the lower margin the ophthalmic vein, the abducent nerve and superior and inferior divisions of the oculomotor nerve, as well as the nasal branch of the ophthalmic nerve enter the orbit. The roent-

genographic demonstration of the sphenoidal fissure is simple. The patient's head is placed facing the film, the horizontal and median planes perpendicular to the film, and the central ray is aimed toward the point of intersection of the median plane with the line connecting the centers of the two orbital outlets. The sphenoidal fissures of both sides are thus projected into the areas inclosed by the shadows of the two orbital margins. Very little of the roof or inner wall of the orbit is seen in this view. The floor area is covered up by the shadow of the petrous pyramid. The remainder and major part of the orbital area is occupied in this view by the outer wall of the orbit. This is the straight posteroanterior view, and it brings out very clearly the lesser wing of the sphenoid and will demonstrate even early pathological changes within it, or erosions produced by tumors above it in the anterior fossa or below it in the orbit.

The outer wall of the orbit is shown in the posteroanterior roentgenogram free from interfering shadows of any structures between it and the film. The outline of this wall is seen in the axial view. In the lateral view taken of the orbit to be investigated this wall is nearest the film; but the projection of the orbit of the opposite side and of the ethmoid cells offers so much interference that only gross pathological changes of this wall are seen in this view.

In the roentgenogram of the cross section of the optic canal the inner wall is projected free from interfering shadows into the area inclosed by the orbital margin. Its outline is seen in the axial view.

The lateral view must be taken for each orbit separately. The patient's head is placed with the orbit to be investigated toward the plate, the median plane parallel to the plate, and the horizontal plane of the head perpendicular to the plate, and the central ray of the tube, which is kept as in the other views perpendicular to the plate, is centered over the middle of the lateral (temporal) orbital margin. This brings the central ray approximately over the center of area of the anteroposterior section of the orbit. This view is also of some value in investigating the malar bone and the distribution and condition of the ethmoid cells.

The axial view can be taken of both orbits at the same time. The rays can be projected from below upward (mentovertical position) or from above downward (verticomental position). Although in the former position one gets the orbit a little nearer to the plate, less interfering shadows are obtained in the latter position. The mentovertical position is used where one seeks supraorbital pathology. The verticomental roentgenogram is obtained by placing the patient's head with the chin on the plate, the median plane of the head perpendicular and the horizontal plane parallel to the plate. The central ray is aimed at right angles to the plate through the midpoint of the horizontal line connecting the outer margins of the orbits. It is therefore perpendicular to this line and lies in the median plane of the head. This view gives a clear outline of the inner and outer walls of the orbits as far back as the apex; also a good top view of the frontal and sphenoidal sinuses and of the malar bone.

By means of optic canal roentgenography fractures, exostosis, periosteitis, and tumors of the canal wall, constriction by hyperostosis, sphenoidal disease and skull deformity, enlargement of the lumen of the canal by optic nerve tumors, destruction of the roof of the canal by frontal tumor, and variations in the shape of the cross section have been demonstrated. The profile roentgenogram of the optic canal may confirm pathology found in the roentgenogram of the cross section or demonstrate pathology not found on the latter roentgenogram, such as transverse fractures, etc. This is a new method of optic canal investigation which opens new possibilities.

For detecting and localizing orbital and ocular foreign bodies the machine used is essentially the same as Dixon's modification of the Sweet apparatus. Greater rigidity and speed of adjustment have been obtained by eliminating the gearing; and precision of adjustment has been increased by sighting along a system of cross lines instead of through a "V" notch when centering the tube. By the use of a tube of sufficiently fine focus, the author has been able to detect metallic foreign bodies a little less than 0.2 mm. in diameter and a little less than 0.33 mm. long. For this purpose a lateral view is used with the plate on the side to be investigated and the tube on the opposite side. The localization is made graphically from the roentgenograms. The Holm scale can be photographed at the same time and used as a check on the graphic localization.

Roentgenograms of the mastoids as ordinarily taken are not of use in the examination of the petrous pyramid. A lateral view of this pyramid is obtained by the Schüller technique either with or without aid of the Bucky diaphragm. The complete examination of the pyramid requires in addition a posterior view and a top view. The posterior view is taken by the de Kleyn and Stenvers technique.

The top view of the pyramid is taken by the Mayer technique. Both these views are of great importance in demonstrating pathology of the apex and roof of the pyramid and adjacent structures. Brief reports are given of 12 illustrative cases.

MAYER, ERNST G. Roentgenological analysis of an unusual deformity of the temporal bone and the technique of its examination. *Acta radiol.*, March 15, 1926, v, 135–142.

Roentgenologic examination was made by three methods: (1) the Schüller technique; (2) the Stenvers technique, and (3) the Mayer technique. The first gives a view of the mastoid, the os tympanicum, the tegmen and the sinus; the second shows the whole pyramid and the labyrinth, and the third the auditory passage and the middle ear spaces.

The case described occurred in a girl, aged thirteen, referred for roentgen examination with the following clinical symptoms: deafness through disturbance of sound conduction, right external ear slightly malformed, auditory passage narrowed from above, tympanic membrane visible, manubrium mallei thickened and slight paresis especially of the third facial branch.

The roentgen examination disclosed the pars mastoidea, pyramids, and os tympanicum of normal size; the styloid process was short, plump and shifted somewhat laterally. The mastoid process was spongious and showed no signs of cells. The antrum was broad, irregular but sharply outlined. The aditus was considerably broader than that of the healthy (normal) side. The attic was not recognizable, whereas on the normal side it was large. In the region of the oval window there was an irregular exostotic island of sclerosis corresponding, presumably, to the malformed and very much thickened ossicle. The external auditory passage and apparently also the ventral portion of the tympanic cavity were narrowed from above by an enormous hyperostosis of the roof.

MILANI, EUGENIO. Roentgenology of the normal jejunum and ileum. *Arch. di radiol., Naples*, Jan.-Feb., 1926, ii, 3–49.

Earlier writers agreed in saying that it was impossible to distinguish the different parts of the small intestine, except perhaps the first loop of the jejunum and the last loop of the ileum but the author and Rieder have worked out quite clearly the topographical and morphological characteristics of the jejunum and ileum. These two parts of the intestine are easier to differentiate from each other in infancy and early childhood than they are in later life. There are two types of arrangement of the jejunum. In the first type the loops are arranged regularly above each other in the left part of the abdomen; the arches are short and sometimes the lower ones are crowded close together. In the second type they are median in position and are in the form of large festoons lying horizontally one above the other. The ileum in general occupies the lower median and right part of the abdomen between the umbilicus and pubis. In individuals with flabby abdominal walls or women who have borne children the lower loops may descend into the pelvis but the course of the loops from left to right is well marked. The boundary between the ileum and jejunum can always be recognized on careful search by the change in form of the loops and by the fact that the loops of the ileum are arranged vertically and sagittally. The loops of the jejunum have a characteristic feather-like appearance with numerous indentations on the margins close together representing Kerkring's valves. The ileum is larger and the picture more uniformly ribbon-like, with only a few indentations on the margin, which disappear in the lower part.

The picture varies somewhat depending on the consistency of the contrast medium, the emptying time of the stomach, the period of digestion during which the pictures are taken, and the tonus of the walls. The author finds that a contrast medium of syrupy consistency is better than a more solid one. The pictures should be taken with a brief exposure of $^{2}/_{10}$ to $^{3}/_{10}$ second and preferably with the patient standing.

The loops of the jejunum with their characteristic feathered appearance are clearly visible within fifteen minutes of taking the barium meal, arranged horizontally in the upper left part of the abdomen; they are still visible after an hour, but in an hour and a half the jejunum is only slightly filled; after $2^{1}/_{4}$ hours it is again clearly visible, but this second period of filling is irregular; it increases at $3^{1}/_{4}$ hours and the loops are again arranged in series with the feathered appearance, especially of the lower margins. At $3^{1}/_{2}$ and $3^{3}/_{4}$ hours there is still considerable filling but it is irregular and the arrangement of the loops is no longer regular. Only slight rests of barium appear after four hours.

The loops of the ileum are visible in fifteen minutes and still more clearly in half an hour when they can be clearly seen in the lower right part of the abdomen. They become more clearly marked as the jejunum empties. At this time they present the characteristic ribbon-like pictures. When the jejunum fills the second time typical pictures of segmentation of the ileum appear ($2^{1}/_{2}$ hours) and rhythmical

movements of division at $2\frac{3}{4}$ hours. The picture of the ileum breaks up into segments at about three hours and in the late period of ileal digestion clear rhythmical movements of division can be seen. After $4\frac{1}{2}$ hours there are only slight rests in the prececal tract while the loops below the cecum are well filled and the barium can be seen passing through the ileocecal valve; after $5\frac{1}{2}$ hours it is hard to differentiate the cecum and ascending colon and in six hours there are only slight rests in the distal loops while the cecum and ascending colon are well filled.

RÉVÉSZ, VIDOR. The direct roentgen diagnosis of peri- and paranephritic abscesses and the roentgen examination of chronic perinephritis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, January, 1926, xxxiv, 48–61.

Para- and perinephritic abscesses can be directly demonstrated in a roentgen examination by a comparison of the pictures of both kidney regions. The abscess itself appears alongside or over the kidney outline as a separate shadow. One can see an apparently very much enlarged, usually somewhat deformed silhouette owing to the fact that the whole adipose capsule is infiltrated and its outline is superposed on that of the kidney. This picture is present no matter where the location of the abscess in or on the kidney. Moreover, simple chronic perinephritic infiltrations and induration of the fatty capsule (and even thickening of the fibrous capsule alone) become roentgenologically demonstrable as enlargement and slight deformation of the kidney shadow. Sometimes one may even distinguish the boundary between the kidney and the infiltrated capsule.

QUESADA, FORTUNATO. Technique for the roentgen diagnosis of fractures of the clavicle. *Surg., Gynec. & Obst.*, March, 1926, xlii, 424–428.

Because of the failure of the classical roentgenographical technique in giving the author information in the case of clavicular fracture regarding the number of fragments, the direction of the line of fracture, the degree of overriding and the distribution of comminuted bone, a new technique has been devised which has proven satisfactory. The method depends upon the taking of two roentgenograms at right angles to each other employing oblique projection of the rays. This technique has been carried out with great precision by means of an instrument which consists of a quadrant of 90° with a perpendicular arm mounted at each end. One of the arms reaches to the center of the quadrant and is furnished with a concave depression to fit the contour of the clavicle. The other arm is at right angles to the first and slides in a channel. The subject to be examined is laid face down upon the table, and a film is placed under the clavicular region. The roentgen tube is placed in the first position with the rays centered parallel to the axis of one of the arms of the quadrant and the first roentgenogram is taken from above downward. Then the film is changed and the tube is shifted so that its rays center parallel to the axis of the other arm of the quadrant. In making the roentgenogram from the head obliquely downward toward the trunk, it is important to push the film a little bit toward the thorax, and in the roentgenogram taken at right angles to this the film should be pushed in the other direction.

A comparison was made of this technique with the ordinary roentgenographic and stereoscopic procedures. Examples are given demonstrating that the new technique above described gave the complete and necessary information regarding the clavicular fractures, while the classical technique failed to do so.

RIGLER, LEO G. Cholecystography by the oral method. *Journal-Lancet*, Feb. 1, 1926, xlvi, 65–66.

A large number of experiments were conducted on the oral method of administering the dye at the Minneapolis General Hospital. Two main objections to the oral method were found to be: (1) the dye caused nausea and vomiting, and (2) it became insoluble when in contact with the acid gastric juice and was not absorbed. By alkalinizing the stomach prior to giving the dye some good results were obtained, but they were not consistent. Passing the substance directly into the intestine was very effective, but the technical difficulties in some cases made it impracticable as a general method. Salol coated capsules and pills were also used with some success.

The present method employed is similar to that described by Whitaker and Milliken. Sodium tetraiodophenolphthalein is administered in pills or capsules protected by stearic acid or by keratin. The patients are sometimes nauseated, and occasionally may vomit the dye. Faulty preparation of the pills may result either in rendering the material insoluble by contact with the gastric contents or in failure of the coating to dissolve at all.

The method is dependent on a fairly intact liver function, so that in cases of severe liver disease evidence suggesting a pathological gallbladder might be obtained even if the gallbladder were normal. Usually these cases may be ruled out clinically with ease. Jaundice is the only contraindication to the test; the result is unsatisfactory and some toxicity usually is

manifested. The author's experience is that the test has excellent possibilities. So far in all cases explored surgically, the diagnosis made by this method has been correct. In a number of cases the gall-bladder was found far removed from its usual location. It is emphasized that the method is not yet a finished one and there is much to learn about its application. It seems not to be a simple matter to decide whether the test is negative or positive. It requires fully as much study and experience and judgment as the barium meal examination of the gastrointestinal tract.

ROENTGEN AND RADIUM THERAPY

ALBERTI, OLINDO. Is there an occupational retinitis from roentgen rays? *Radiol. med.*, June, 1926, xiii, 401–414.

The author discusses a case of atypical pigmented retinitis which was observed in an old roentgenologist and which a distinguished oculist interpreted as being an occupational lesion due to the direct action of roentgen rays. The author with a view to determining whether this interpretation was correct and applying the results technically and in treatment made a study of the roentgen sensitiveness of the different tissues of the eye, particularly the retina, and the limit of their tolerance to the rays. He also made an exhaustive study of the literature of roentgenology to see whether roentgenologists, particularly those who had worked intensely and for a long time at the specialty, had had any ocular lesions and if so what kind.

His conclusions were as follows: (1) From a theoretical point of view and according to all that is known of the radiosensitiveness of tissues, it does not seem probable that an occupational lesion of the retina caused directly by roentgen rays could be produced without being accompanied by lesions in any other part of the eye, particularly its anterior segment.

(2) In the experimental field notwithstanding the great variety of results obtained in experiments performed to determine the radiosensitiveness of the different tissues of the eye it seems (*a*) that ocular lesions produced experimentally by roentgen rays have always been caused by doses larger than therapeutic doses; (*b*) that these lesions have never been found in the retina alone, for they affect other parts of the eye at the same time, particularly the anterior segment; (*c*) that in the retinal lesions which have been produced the characteristic changes were not those of the atypical pigmented retinitis in question.

(3) In the clinical field the findings were similar, that is to say (*a*) the lesions seen in eyeballs irradiated for therapeutic purposes have always been brought about by doses larger than those considered the maximum doses by careful roentgenologists; (*b*) lesions have often been seen in the anterior segment of the eye without any lesions of the retina, but the converse has never been seen; (*c*) the character of the retinal lesions observed has not been that of the atypical pigmented retinitis in the above case.

(4) In the professional field (*a*) no case of occupational lesions of the retina caused by roentgen rays has so far been reported in a roentgenologist; (*b*) professional lesions of the face, eyelids and different parts of the eyeball, conjunctiva, cornea, crystalline lens, have been observed but they have never been accompanied by lesions of the retina.

The author believes that all these facts furnish good evidence that the atypical pigmented retinitis in this case was not caused directly by roentgen rays. He believes that it was more probably the result of a general pathological condition, probably due to a disturbance of metabolism.

ZUPPA, ARMANDO. Roentgen treatment of skin epitheliomas by Guarini's modification of Ghilarducci's method. *Arch. di radiol.*, Mar.–June, 1926, ii, 196–208.

Ghilarducci has described his method in numerous articles. The essential principle of it is to apply rays with different degrees of filtration, in addition to making use of the secondary irradiation produced by iontophoresis. Guarini uses variable filtration alone without iontophoresis, and instead of passing from 1 mm. to 4 mm. aluminum filter at one step he uses 1, 2, 3, 4 and 5 mm. His plan is as follows: five minutes with 1 mm. aluminum filter, 5 minutes with 2 mm. aluminum, 5 minutes with 3 mm. aluminum, 10 minutes with 4 mm. aluminum, one skin erythema dose with 0.5 zinc and 2 mm. aluminum or 10 minutes with 1 mm. aluminum, 10 minutes with 3 mm. aluminum, 10 minutes with 5 mm. aluminum and then one skin erythema dose with 0.5 zinc and 2 mm. aluminum. The time of irradiation with the zinc filter of course varies, depending on the distance from the anticathode to the skin.

The object of this method is to decrease progressively the amount of soft irradiation used and spectometric examinations have shown that, with a constant electric current, the minimum wave length remains constant; the increased filtration simply cuts off the soft rays progressively.

Eight cases of different forms of skin epithe-

lioma treated by this method are described and illustrated by photographs of the patients before and after the treatment. The results were excellent in all of them, showing that Guarini's method gives good results in various clinical forms of skin epithelioma.

Trueheart, M. Cancer of the lip—Report of 25 cases treated with radium. *J. Kansas M. Soc.*, October, 1926, xxvi, 311–313.

The series of cases of cancer of the lip here reported were treated at the Sterling Hospital, Sterling, Kansas, between August, 1922 and January, 1925. The treatment consisted of external irradiation of the lip, insertion of needles being applied only in those cases in which the glands were palpably involved. In the ordinary case with small lesion of the lip, the author used four needles containing a total of 44 mg. radiant material screened with 2 mm. Cu and 1 mm. Al. The first treatment lasted forty-eight hours and after the resulting erythema subsided (about three weeks) a second treatment of twenty-four hours was given producing a similar erythema. After a second erythema. subsided another twenty-four hour treatment was given. This was almost invariably sufficient to cause the lesion to heal. In involved glands 10 mg. needles were inserted and allowed to remain for ten hours and in addition there was administered an erythema dose of deep roentgen rays over the gland-bearing area of the neck.

Two of the cases had the upper lip involved and both of these have remained well since treatment. The lower lip was involved in 23 cases and of these 2 are dead, 3 have had recurrences and the remainder are well.

The author's experience with radium in the treatment of cancer of the lip shows that it offers as good a hope for curing this disease as any other method of treatment if used as the primary treatment at the time when the diagnosis is first made. It has the advantage over other treatments of being able to salvage some of the cases that have been operated on or have used paste or roentgen rays without cure. The most important item in the cure of this condition is early diagnosis and early proper treatment.

MISCELLANEOUS

Alberti, W., and Politzer, G. The practical interval in multiple irradiation of malignant tumors. *Strahlentherapie*, 1926, xxi, 535–549.

Experiments on salamander larvae which were kept in water at different temperatures, and studies on mouse embryos have shown that the changes caused by roentgen rays in embryonal tissues (the primary effect, mitosis-free interval) follow the van't Hoff law governing the relation between reaction velocity and temperature. It was found that an increase of tissue temperature of 10° increased the speed of reaction two to three times. It was shown for embryonal tissue that the effect of fractional irradiations, when the intervening periods are correctly timed, is a multiple of the effect obtainable by a single irradiation with a dose equal to the sum of all the fractional doses. If this observation is applicable in the case of malignant tumors we may expect an unusually powerful destructive effect of any quantity of roentgen rays when the total dose is applied in two or three fractional doses with intervening pauses of about twenty-four hours.

Histological studies and irradiation experiments of this type performed by others on animal and human tumors appear to confirm the above conclusion. The authors urge for the treatment of malignant tumors the fractional method of irradiation with pauses of about a day, done in conjunction with histological controls in suitable cases.

Bendove, Raphael. The mechanism of localization of gas in the pleural cavity and its clinical application in pneumothorax therapy. *Arch. Surg.*, September, 1926, xiii, 369–390.

The difference in the elasticity of the diseased and non-diseased lung tissue, as well as the difference in the intrapulmonary and intrapleural pressures makes it possible for the gas introduced into the pleural cavity to localize itself over the diseased portion without curtailing much of the function of the unaffected portion of the treated lung, provided the amounts administered are small and are given at frequent intervals. These pneumodynamic principles should be made use of in every case treated with artificial pneumothorax. They are most applicable, however, in cases of the exudative type of pulmonary tuberculosis of not very long duration and free from pleural adhesions. In such cases pneumothorax therapy is not to be regarded as a last resort measure, but as the treatment of choice, since it offers more rapid and more complete anatomic and functional recovery.

These pneumodynamic principles of gas localization cannot as a rule be applied in cases of the productive or proliferative type of pulmonary tuberculosis because such cases usually run a mild course, and when they begin to manifest severe symptoms they are usually far advanced and present marked pleuritic adhesions making a pneumothorax inapplicable. In such cases thoracoplasty is the indicated

treatment, provided the other lung is in good condition.

A slight or even moderate involvement of the other lung is not a contraindication to artificial pneumothorax of the expansile type because the function of the undiseased portion of the treated lung is not much curtailed and little demand is made for extra respiratory function on the other lung. The insufflatory amounts in such cases should vary from 200 to 400 c.c. and the intervals from five to ten days. No generalization can be made but each case must be individualized depending on its vital capacity and the extent of involvement. This can be studied only by frequent roentgenoscopic observations and periodic spirometry.

BARDACHZI, FRANZ, and EPSTEIN, PAUL. Dosimetry in roentgen therapy. *Strahlentherapie*, 1926, xxi, 419–425.

In the newer type of Fürstenau intensimeter the disadvantages of the older forms appear to be eliminated, especially the selenium error. The depth doses determined by the intensimeter are much lower than the corresponding readings shown by the iontoquantimeter. However, the late model of intensimeter shows a close approach to the iontoquantimeter in readings of percentage dose. A further check of the measurements was made by a new modification of the Kienböck procedure, and this showed that the dose values determined with silver bromide paper agree with those obtained by the early type of Fürstenau intensimeter and do not agree, as was to be expected, with the readings of the iontoquantimeter. The pointer readings of various intensimeters show considerable differences so that the F readings of an instrument do not indicate the required dose without further checking. It seems to be important, therefore, to calibrate each instrument by the iontoquantimetric and biological methods. The radiometer of Holzknecht shows satisfactory accuracy and may be advantageously employed as a control instrument in deep therapy.

BJÖRLING, E. A method of measuring roentgen rays, particularly in skin therapy. *Acta radiol.*, June 30, 1926, v, 267–283.

The object of the method is to enable the operator to estimate a given dose of roentgen rays, qualitatively and quantitatively, by a standard measurement that can be reproduced in different localities. Reproducible measurement of quality is found in the half-value-layer for absorption; and of quantity in the optical standard light (Hefner). Any statement regarding the half-value-layer of a radiation must include not only the material measured but also the measuring agent; in the author's technique the latter is a photographic plate.

The author's method for measuring the practical half-value-layer depends in principle upon the reduction of a radiation to one-half by absorption and comparing this with the reduction to one-half by distance. In the actual measurement, one determines that strip of an aluminum "stair case" (or of copper, silver or bakelite) that has reduced part of the cone of rays through absorption to the same degree as another part of the same cone has been reduced by lengthening of the focal distance by $\sqrt{2}$ times the focal distance of the first part.

For quantitative measurement the author employs as the absolute standard the Hefner optical unit. He has devised an electric standard light apparatus having for its object the production of the photochemical equivalent of one standard unit or multiple upon photographic paper. The author's standard unit is one opton, which is equal to the photographic effect of one Hefner unit at a distance of 10 cm. during one minute. To enable a given dose of roentgen rays to be measured in terms of optons, its effect must be transformed into optical light. This is done by means of small fluorescent screens containing calcium tungstate. This method is claimed to have advantages over the method of Kienböck and of Sabouraud. There should be no difficulty in translating the above unit for any half-value-layer into the international R unit.

BOISSEVAIN, C. H. The effect of beta-rays on bacterial growth. *Am. Rev. Tuberc.*, August, 1926, xiv, 172–176.

It seems a hopeless undertaking to try to prove the importance of the beta rays of potassium by means of experiments with perfusion of the heart. It is different when we study the effect of minerals on bacterial growth in synthetic media. The author chose Long's synthetic medium to study the question of the replacement of potassium by other elements in the culture of the tubercle bacillus. Potassium chloride and sodium phosphate were substituted for the potassium phosphate of the original solution thus permitting the substitution of other alkali chlorides. Other media were prepared containing in place of the potassium either lithium, sodium, rubidium, caesium, vanadium, or uranium. The various media were inoculated with human tubercle bacilli. Good growth was obtained in the medium containing potassium chloride and even better where rubidium chloride was found. The growth in the medium containing uranium was only about one-tenth that of the growth in the potassium medium. None of the other

media showed growth. Where growth did occur, virulence tests showed the tubercle bacilli to be normally virulent to guinea pigs.

Caesium and rubidium are chemically very closely related and extremely hard to separate. One of them favors the growth of the tubercle bacillus even more than potassium does, and the other is without any effect. These results suggest that the beta rays of potassium and rubidium may have some importance. It seems curious that elements with beta radiation are necessary for the life of the tubercle bacillus when we recall that this organism is killed by the action of ultraviolet rays. It appears that the electrons from potassium have a velocity less than the photoelectrons of ultraviolet radiations.

BORAK, J. Present methods of irradiation of malignant tumors from the standpoint of the dose distribution with respect to time. *Strahlentherapie*, 1926, xxi, 380–388.

Every malignant tumor seems to demand a special mode of irradiation or combination of methods depending upon the organ, the topographic-anatomical position and its extension. There appear to be six generally accepted methods of roentgenization. The first is the *single irradiation* treatment originated by Holzknecht, who urged this method because reduction of the time of treatment appeared most rational. Another advantage of the single exposure is the ability to determine exactly the effect produced by the dose, which is not possible where the summative effect of repeated doses is introduced. Moreover, as Seitz and Wintz have shown, a more pronounced effect can be obtained by a single dose than by a number of divided doses. Although the single dose method reduces the time of treatment in the case of superficial skin diseases, this is not true for deep-lying malignant tumors. The reason for this lies in the fact that the dose necessary to effectively treat malignant tumors in internal organs might involve serious hazard of injury, both direct and indirect, local and general.

The second method of roentgen treatment is termed the *maximalizing method* of irradiation and consists in a distribution of the dose over several successive days. This method is preferred by the author and consists in establishing a maximum daily roentgen space dose which should not be exceeded. From the required total dose for a tumor one may calculate on this basis the number of days necessary for administering the required dose without exceeding the maximal daily space dose. Thus a small skin carcinoma may be irradiated at a single sitting while larger tumors may require several days.

The third method is called the *fractional method* of irradiation. It is also based upon the principle of maximalizing irradiation. This consists of three fractional treatments on successive days followed by a pause of several days and by three further fractional treatments on successive days. This treatment is employed in very large tumors that cannot be included in the maximum 15×15 cm. field, and in tumors of certain regions such as the mediastinum or larynx where a too intense irradiation results in dangerous reactions; thirdly in tumors localized in certain areas where an irradiation will produce pronounced general disturbances as, for instance, in tumors of the upper abdomen; fourthly, in cases of special debility of the patient, and fifthly in cases of pronounced roentgen idiosyncrasy as demonstrated by a test irradiation. Under these conditions only one-half of the maximum daily dose is administered at a sitting.

The fourth method of treatment is termed the *protracted treatment* (continuous irradiation). This method is favored by Regaud, among others. It consists in repeated daily irradiations, the effect being summative.

The fifth form of treatment is described as the *intermittent method* in which a small dose is administered at intervals of two or three days. This method is based upon the observations of Alberti and Politzer upon the cornea of salamander larvae. The difficulty about this method is that there is no basis for determining the magnitude of the first dose which is necessary to produce the reaction required at the time of the second dose.

The sixth method is known as the *saturation method* recommended by Kingery for skin therapy and Pfahler for deep malignant tumor. This method depends upon the assumption of an exponential decrease of the roentgen reaction in tissues. As a matter of fact, the skin erythema is the only phenomenon showing even an approximation to the exponential curve. Another criticism of the method is that its proponents appear to have neglected consideration of the first portion of this curve which shows an increase before the onset of the logarithmic decrease. The method consists in administering in the course of a few days 80 per cent of the skin unit dose as the surface dose per field on the assumption that 100 per cent of the dose reaches the tumor. In the course of the next ten to fourteen days successively smaller doses are administered down to the limit of tolerance. This procedure

is regarded as having nothing to do with the idea of the exponential decrease of the roentgen reaction but is merely an attempt to make use of the principles of irradiation of Regaud and also of Alberti and Politzer. Moreover, the exact relationship of dosage to the time of further irradiation is based on the tolerance of the normal organs and not on the processes in the tumors. Nevertheless Pfahler's method represents a very earnest attempt, although one still to be proven by experience, to better utilize organ tolerance.

BORNHAUSER, OSKAR, and HOLFELDER, HANS. The problem of the intensity distribution of roentgen rays in an irradiated medium. *Strahlentherapie*, 1926, xxi, 494–507.

The work of Lorenz and Rajewsky is shown to be essential confirmation of the work of the authors, and establishes considerable corrections in certain important points to the Dessauer isodose curves. The authors point out that the application of various ray qualities leads to only quantitative variations in the depth effect of the beam of rays, while the fundamental form of the central ray dose curves as well as of the isodose curves remains the same.

BRUMMER, K. Further observations on the changes in cell permeability under roentgen irradiation. *Strahlentherapie*, 1926, xxi, 447–451.

Blood was carefully defibrinated by slow stirring for twenty minutes (a smear showed all the erythrocytes intact) and 10 c.c. of the blood was pipetted into a number of centrifuge tubes some of which were kept as controls and others irradiated with varying doses of roentgen rays. The roentgen machine was operated at 2 ma., half value thickness 1.5 cm. After this, 1 c.c. of roentgen dose an increased isotonic methylene blue solution as added, the tubes were centrifuged for 5 minutes and the supernatant plasma was observed colorimetrically. There was observed with increased roentgen dose an increased coloration of the supernatant plasma.

Tests showed that the erythrocyte number and hemoglobin content had no appreciable effect on the change in permeability produced by irradiation. The curve was appreciably affected by the time of interaction of the methylene blue and the blood.

More extensive experiments show that the change in permeability due to the action of roentgen rays can be demonstrated for individual cells, especially erythrocytes. It was found that the time of interaction between the dye and the cells had to be short for this decrease in permeability to be demonstrated. The curve showed a pronounced drop with small roentgen doses and a flattening of the curve at higher doses.

CAPPELLI, LUIGI. The biological factor in radiotherapy. *Radiol. med.*, May, 1926, xiii, 347–369.

Bergonié and Tribondeau stated that the radiosensitiveness of cells was greater the more actively they were undergoing karyokinesis and the less differentiated they were. Cappelli believes that while this is in part true it does not cover the whole of the general biological law in regard to radiosensitiveness. He finds that the radiosensitiveness of the cell runs parallel with its vital energy, that is to say, with the activity of its metabolism.

In his study of the action of rays he found the following facts: (1) Homologous skin areas in different individuals when irradiated react differently to the same dose of radiation; (2) the same tissue when hyperemic is more sensitive to rays when ischemic; (3) the same tissue when cold, responds less to irradiation than when hot; (4) the skin of warm-blooded animals is, in general, more sensitive to rays than the skin of cold-blooded ones; (5) leucocytes which are very radiosensitive *in vivo* become radioresistant *in vitro;* (6) a seed, when irradiated, does not die, and does not show the effect of irradiation until a year later when it germinates and its chlorophyl function becomes established; if the same dose which was used on the seed were used on a young plant it would kill it quickly; (7) two cancers of the same morphological appearance react differently in two different subjects of the same species; (8) the radiosensitiveness of a tumor of the same structure varies in different sites of implantation; (9) a cell which is functioning is more radiogenerative than one at rest; (10) there is a latent period between the irradiation and the biological reaction which varies with ontogenetic and phylogenetic youth of the tissue and the size of the dose; (11) sometimes there is a second reaction days, months or even years from the first reaction; (12) a tumor which has been repeatedly irradiated acquires a certain resistance to irradiation and may finally become almost entirely insensitive to it; (13) a normal tissue, on the contrary, becomes more sensitive to a second irradiation.

All of these facts are in harmony with his theory that radiosensitiveness increases with increasingly active metabolism, while some of them cannot be reconciled with the theory of Bergonié and Tribondeau. He emphasizes the fact that it is not the quality of the metabolism but its intensity that is to be considered. The different sensitiveness of homologous areas of

the skin in different individuals cannot be explained by a different degree of karyokinesis but by differences in intensity of metabolism, for it is well known that different individuals have different rates of metabolism. For instance the metabolic rate in hyperthyroid subjects may rise to 125 per cent of the normal rate and hyperthyroid subjects are known to be particularly radiosensitive, to such an extent that special precautions are necessary in giving them roentgen treatment.

Hyperemia is known to increase the radiosensitiveness of a region. It does not increase the percentage of mitoses, but it does increase the intensity of metabolism. The same statement applies to findings (3) and (4). Leucocytes are radiosensitive *in vivo* but not *in vitro*. This is due to the fact that their metabolism is slowed in the effort to adapt themselves to the new surroundings. Finding (6) is in harmony with both the author's theory and that of Bergonié and Tribondeau. The young plant is more actively karyokinetic than the seed, and its rate of metabolism is also greater. That two cancers of the same morphological appearance react differently in two individuals can only be explained by differences in individual metabolism, and their different radiosensitiveness at different sites by differences in local metabolism. The metabolic rate of different sorts of tissue varies. A cell which is functioning specifically is more radiosensitive than one at rest; its metabolic rate is greater. The theory of Bergonié and Tribondeau does not explain the latent period or the secondary reaction as there are no differences in karyokinesis to be invoked. A normal tissue on being irradiated reacts with inflammation and increased metabolism and therefore becomes more sensitive to a second irradiation, while a tumor acts like a parasite and defends itself by decreasing its metabolism against the new conditions produced in its environment by the irradiation.

A careful study of all these findings will show that radiosensitiveness varies, not with histological structure, but with functional activity. The very fact that two tumors, different in histological structure, react differently to irradiation shows that the vitality of a biological tissue is variable, and not fixed by its structural type. There is no such thing as selective action of rays on certain morphological types of tissue, but their biological action is uniform and constant and the difference in effect depends on the different vitality, or metabolic rate of the tissues. The author believes that if this law were to become firmly established in the minds of roentgenologists it would lead to great improvements in roentgen technique.

CARELLI, HUMBERTO H., and VIERHELLER, FRIEDRICH. Comparison of the German and French R units. *Strahlentherapie*, 1926, xxi, 468–475.

Experiments have shown that the small carbon ionization chamber of the Solomon instrument is sufficiently accurate for all practical purposes. The German R unit was established for the Siemens Stabilivolt (high tension, direct current) apparatus and it was found that an erythema was produced in 78 minutes by operating with 165.15 kv. at the tube (as measured spectrographically), 7.5 ma., 1 mm. Cu plus 2 mm. Al filter, 42.5 cm. focal skin distance, 14.5 cm. diameter of the field. This time for the erythema dose corresponds to 847 R. In this measurement the ionization chamber was in the air. The effect of recoil energy was measured at the water phantom to be somewhat over 30 per cent of the total roentgen-ray energy producing the erythema. Taking this into account, one obtains the value 1210 R. This result agrees satisfactorially with values recently established.

The French R unit was determined according to the specifications of Solomon, the standard of reference being three different preparations of radium bromide filtered through 0.5 mm. platinum. The roentgen machine was operated under the same conditions as above, and standardized according to the French unit, the erythema dose was found to be 2249 French R. These experiments show that 847 German R equal 2249 French R units. That is, the German unit must be multiplied by 2.66 to be transformed into French units. Assuming for a recoil energy the value of 30 per cent of the total intensity reaching the surface, the amount delivered during 78 minutes for the conditions of the experiment corresponds to 1210 German R and 3213 French R.

Under the authors' conditions of operation, measurements with the Holzknecht scale showed that during 78 minutes the roentgen tube delivered 10.6 H units which correspond to the 1210 German and 3213 French R.

EDITORIAL. Irradiation and cell-division. *Lancet*, Oct. 9, 1926, ii, 760–761.

The so-called law of Bergonié and Tribondeau states: "Immature cells and cells in an active state of division are more sensitive to irradiation than are cells which have already acquired their fixed adult morphological or physiological character." Doubt of the correctness of this explanation has been cast by the recent work of Strangeways and his collaborators and of Mottram, Scott and Russ. The former workers state that cells undergoing

mitosis are unaffected by roentgen radiation. The latter workers obtained strikingly similar results with the beta rays of radium.

It is obvious that we must discard the old explanation which attributes the radiation sensitiveness of growing tissues to the presence of cells in the phase of mitosis. Although cytologically the resting cells of a growing tissue are not different from the cells of a non-growing tissue, the new observations show that they differ biologically in their sensitiveness to radiation. Such sensitiveness must be due to some property which the cells of all growing tissues have in common, and it is presumably connected with the process of growth. Since this applies to normal growing cells as well as to cancer cells, it would appear that the mechanism of growth is essentially the same in both.

FRAENKEL, S., and NITSNIEWITSCH, L. On the effect of isolated blood irradiation upon the cell. *Strablentberapie*, 1926, xxi, 452–458.

A total of 11 experiments were performed on dogs having vaginal sarcoma. The blood of these animals was irradiated by the administration of one skin erythema dose to the exposed jugular vein. Control experiments were carried out on four other dogs with vaginal sarcoma, these animals being irradiated directly over the tumor.

The experiments although not closed, show that the direct irradiation of the sarcomas yields the same clinical and histological effects as irradiation of the exposed blood vessels alone. So far as could be observed, the irradiation of the blood vessel produced no injury in the doses administered.

FÜRST, WALTER. The protection of attendants against fatal accidents from roentgen apparatus and the question of responsibility. *Strablentberapie*, 1926, xxi, 508–517.

The author points out the fact that the control switch table of the modern roentgen apparatus should be so constructed that accidental contacts of the operator with open circuits are rendered as remote as possible. The danger is demonstrated in the case of the control switch board of a Symmetrie apparatus in the author's clinic. The danger points in this particular apparatus were: exposed metallic screws of the regulator knobs, metallic clamps of the amperemeter, uncovered metallic leads to the heating current resistance and open leads to the main switch. Screw holes can be covered with paraffin, metallic clamps can be replaced by hard rubber devices and metallic leads can be insulated so as to remove possible danger of shock.

The author is advised by a legal authority that according to German law, the disclaiming of responsibility by the agent of the manufacturer of inadequately protected apparatus will not stand the test of a legal contest in the event of an accident.

GLASSER, OTTO. Erythema dose in roentgen units. II. *Strablentberapie*, 1926, xxi, 476–479.

The quantity of roentgen rays necessary to produce the same biological effect at different wave lengths varies. With the relatively hard rays (average $\lambda = 0.14$ Å) 1400 R units are required to produce the biological effect, while with relatively soft rays (average $\lambda = 0.4$ Å) only about 500 R are necessary to produce the same effect. Consequently in stating the erythema dose in roentgen units it is absolutely necessary to state the quality of rays employed.

GREBE, L. The measurement of the roentgen dose. *Strablentberapie*, 1926, xxi, 306–318.

The intensity of a beam of roentgen rays at any point in space is the quantity of energy entering in one second a sphere of 1 square centimeter cross section described around the point in question.

The effective energy of radiation may be used as a unit of comparison only between homogeneous rays of the same wave length or mixtures of rays of the same composition. This implies that a quantitative comparison of radiations from various instruments or various conditions of operation in the same instrument is not permissible. So far as concerns the effect of radiations upon the photographic plate, it may be stated that equal degrees of darkening produced by different wave lengths correspond to the differences in quantities of energy in the incident beams. The only thing that is determined here is the uniformity of the effective energies so far as the photographic effect is concerned.

Equal radiation intensities in rays of varying wave length do not correspond to equal ionizations. The real factor here is the effective intensity conditioning ionization and not the absolute intensity. Attention is directed to the fact that the establishment of a roentgen dose in terms of R units holds good only for a definite quality of radiation. The roentgen dose is equal to the effective energy as related to the biological action, in other words, it is equal to the biologically effective intensity multiplied by the time of exposure. The specification of a dose in terms of units of the Sabouraud-Noiré tablet or the Kienböck strips or even in terms of intensimeter units has a definite meaning only when applied to a homogeneous radiation

of specified wave length or hardness. Otherwise the dose is not reproducible.

For many practical purposes the difference in the dependence upon wave length between the biological and iontometric effect is so small, and on the other hand, the range of biological reaction is so broad that the iontometric dose and the biological dose may be considered identical, so that it is permissible to define a biological reaction in terms of the R units of incident radiation independently of the wave length. Thus it may be that 1200 R (primary radiation plus recoil scattering) at a point on the skin may be regarded as an erythema dose when considering the customary deep therapy irradiations. Whether this value is applicable also to markedly different ray qualities is, however, questionable. Measurements of purely primary radiation with designation of the hardness and including all other conditions of operation still remains the only safe method for an exact reproducibility of results.

Holthusen, H. The time factor in roentgen irradiation. *Strahlentherapie*, 1926, xxi, 275–305.

Taking everything into consideration, we are still far from the point of being able to designate a definite relation between a certain dose of radiation and its corresponding biological effect. From the standpoint of dosimetry this fact is to be much regretted. So far as we can now see, the question of dosing is not a technical physical problem but an aspect of medical art. The theoretical basis of the various attempts to apply roentgen treatment in fractional dose so as to protract the period of irradiation was the hope to ultimately reach all the cells during the stage of mitosis and at the same time secure an increased summation effect. This idea went so far that probitory excisions were made in order to determine the relation of the number of mitoses in tumor sections to the total number of cells, from which was calculated a "karyokinetic index." From the data thus obtained on the rate of degeneration of the tumor cells, an attempt was made to calculate the length of time necessary to continue irradiations so as to finally reach all the tumor cells during their most sensitive stage. Unfortunately this matter is not so simple. For one thing, various portions of a tumor have different rates of growth depending upon their nourishment and, as a consequence, calculations such as the above would be very much complicated. In addition, observations such as those by Alberti and Politzer showing the existence of intervening phases of absence of mitosis would entirely upset the above theoretical calculations.

Taken all in all, there is clear evidence of the existence of an enhanced summative effect of partial doses of radiation, but we have no knowledge as to its extent nor any clear explanation as to the mechanism producing it.

Kodama, Shuichi. A model to simulate the mechanism of emptying of the gall bladder. *Am. J. Physiol.*, July 1, 1926, lxxvii, 385–388.

Despite the fact that the cholecystographic shadow of the gall-bladder disappears after a varying number of hours, depending on the conditions, no one has so far reported observing by this method anything resembling a peristaltic action of the gall-bladder. The gall-bladder, like all other hollow viscera of the body, is elastic. It can be easily distended and it has a very appreciable elastic recoil when the inside pressure is suddenly relieved. Experimental work described shows conclusively that this simple mechanical principle of elastic contraction is a very important and perhaps the most important factor in the emptying of the gall-bladder. When the sphincter of Oddi is closed the gall-bladder is being constantly distended by the reception of bile. When the intestinal end of the duct is suddenly opened there is a sudden diminution of pressure within the gall-bladder. Elastic recoil then occurs and bile is squirted through the cystic duct with considerable force. Thus the discharge of bile will continue until the pressures have come to an equilibrium. Obviously, therefore, the gall-bladder never empties itself completely at one time as it would if a peristaltic contraction occurred. Its content, however, will gradually undergo dilution and change if a succession of openings and closings of the intestinal end of the duct occurs, because after every closure of the sphincter more liver bile will pour into the partially emptied gall-bladder, which will again discharge some of its contents as soon as the sphincter re-opens. In this way the gall-bladder will be gradually washed out by the repeated opening and closing of the distal end of the common duct.

Kriser, Artur. Roentgen injuries, their prevention and treatment. *Strahlentherapie*, 1926, xxi, 407–415.

Roentgen sickness is no longer a necessary evil in roentgen therapy. It may be prevented by employing test irradiations and small divided doses. The best method of treating it, should it occur, is sodium chloride therapy. It is a good plan to administer salt to the patient one or two days before irradiation and during the period of treatment. Should roentgen sick-

ness then make its appearance, the sovereign remedy is the intravenous injection of 10 c.c. of a 10 per cent sodium chloride solution.

Local roentgen injuries are due to overdosage. The early reaction (swelling through edema) should be avoided especially where it may cause compresson of vital organs. These injuries also are avoided by test irradiations, and by small divided doses distributed over a long period. Epilation through irradiations of the skull may be avoided by employing a small field technique over the facial portions of the skull.

A frequent result of abdominal irradiations in women is injury to the ovaries. This form of roentgen therapy should therefore be conducted only under the strictest precautions and indications. It is claimed impossible to irradiate one ovary without exposing the other, but the scattered rays can be reduced to a minimum by the employment of compression devices and adequate screens. The protection of the testes in irradiations upon males is also of considerable importance. The author has encountered azoospermia caused by scattered rays in the roentgenization of the pelvis or the inguinal region. Perhaps the best means for protecting the testes is the employment of a so-called scrotum capsule which consists of two metal hemispheres made to close over the scrotum.

As regards skin injuries, the most important method of prevention consists in the direct measurement of the superficial dose, which renders one entirely independent of all the varying conditions of operation. The most frequent causes of overdosage are too brief pauses between treatments and omission of filters. The suggestion of Holzknecht to make the pause between two irradiations of as many weeks as the applied superficial dose in H units (i.e., 6 H—6 weeks' interval) is considered a very safe and useful one. Omission of the filter can be corrected by a scheme which makes it impossible to operate the roentgen machine when the filter is absent. A good plan is to stop and measure the superficial dose when one-quarter of a dose is given. By this means the dosage is checked before any very serious damage is inflicted, if there is an error in operating conditions.

Roentgen ulcer is treated by injecting a 0.5 per cent novocain-adrenalin solution around the affected area. From 10 to 50 c.c. of the solution is injected every three or four days for a total of ten injections; and this is repeated after a pause of two weeks. It often becomes necessary to resort to surgical excision. Telangiectases are treated first by anesthetizing the area galvanically with a mixture of cocaine and adrenalin and then employing electrocoagulation.

To indicate whether current is flowing through the high tension leads the author employs two methods. In the first he attaches a bunch of strips of tissue paper around the cable. These strips will fly apart when the current is on. The second method indicates the presence of alternating current in the high tension cable either in the light or in the dark. There is attached to the cable a small tube containing one of the noble gases under reduced pressure. Such tubes become luminescent in the electromagnetic field of high tension alternating currents.

MAINOLDI, PIETRO. Emptying of the stomach with the subject lying on his side. *Radiol. med.*, September, 1926, xiii, 655–663.

Mainoldi studied 50 subjects; after giving them an ordinary opaque meal of barium he had them lie one day on the right side and the next day on the left and compared the emptying time in these two positions with that when the patient was standing upright. He finds that in general, emptying takes place with considerably greater rapidity in right lateral decubitus, except in cases where that position causes the patient pain, as for example if the stomach is compressed by an enlarged gall-bladder. But in left lateral decubitus emptying is slower than in the upright position, although this retardation is not so constant as the acceleration in right lateral decubitus. He finds that examination in right lateral decubitus is very useful in cases of hypotonic stomach with lowering of the lower pole for in these cases there is retardation of emptying in the upright position. If in such cases the retardation of emptying disappears in the right lateral position it will give indications as to the treatment to be pursued.

MARAGLIANO, VITTORIO. Cosmic radioactivity. *Radiol. med.*, August, 1926, xiii, 529–533.

Recently reports have appeared in the scientific journals that the American physicist, Millikan, has discovered in the atmosphere radiations of short wave-length with a penetrating power greater than that of the gamma rays of radium. He calls these cosmic rays. Maragliano calls attention to the fact that he published a hypothesis similar to that of Millikan in the Acts of the Italian Congress of Radiology, Rome, 1920. In this publication he stated clearly: (1) that it is possible that there are extra-terrestrial rays that have an intense power of penetration; (2) the atmosphere may be of great importance as a filter

and selector of these extra-terrestrial rays; (3) it is impossible by ordinary methods to demonstrate these rays.

PALUGYAY, JOSEF. A measuring and adjusting apparatus for the roentgen irradiation of collum carcinoma of the uterus by the Wintz method. *Strablentherapie*, 1926, xxi, 389–396.

The various devices employed for exact placement of the tube and measurement of the distances have their limitations in the fact that their simplicity of operation has been made at the cost of precision. In the roentgen treatment of collum carcinoma by the Wintz method it is highly important to make all adjustments with precision.

The author has therefore constructed a new apparatus which permits very accurate adjustment and measurement but which requires some practice before it can be effectively employed. This instrument is described in detail and illustrated.

PARKES, A. S. On the occurrence of the oestrus cycle after x-ray sterilization. Part I. Irradiation of mice at three weeks old. *Proc. Roy. Soc., Lond.*, Aug. 3, 1926, c, Ser. B, 172–199.

The experiments recorded suggest that there exists in the mammalian ovary a periodicity which is responsible for the cyclic development of Graafian follicles and the coincident cyclic action of the hormone, causing the requisite hypertrophy of the uterus. In the elimination of follicles through irradiation or other destruction, the rhythmic action of the hormone proceeds in the normal way, but is unaccompanied by ovulation. These conclusions have a not unimportant bearing on the theory of the human menstrual cycle. Results of irradiation of the human ovary appear to have been somewhat contradictory, but most authors agree that amenorrhea is brought about temporarily if not permanently by adequate exposure. The present results suggest that irradiation does not inhibit the appearance of estrus and thus presumably estrus should occur after roentgen sterilization of the human subject. If this view is correct menstruation which is inhibited by irradiation is not the physiological analogue of the estrus period of the lower animals and is probably therefore of the nature of pseudo-pregnant degeneration as has also been suggested by the work of Seitz and Wintz.

These conclusions are based upon experiments made upon mice. Twenty-five animals were sterilized by exposure to roentgen rays at the age of three weeks. The factors for irradiation were: 50 kv., 5 ma., wave length 0.285 Å, spark gap point to point 5.3 cm., medium Coolidge universal tube, anticathode distance 18 in., no filtration. The treatment was applied for 80 min. in two exposures of 40 min. each which were found to sterilize the females with perfect regularity. When puberty was reached, 22 of these experiment animals experienced at least one period of estrus. In all, 53 periods of estrus were observed in these animals, many of which exhibited a series of complete cycles of the normal length. None of these animals had oocytes, follicles, or follicular tissue in the ovaries, which was determined histologically, and it therefore appears that the cyclic structures of the ovary are not essential for the occurrence of the normal cyclic activity of the uterus and vagina. It would seem that the estrus-producing hormone is elaborated by the interfollicular tissue, though also possibly by the follicles under normal conditions. It also appears that the normal ovary possesses some cyclic mechanism which brings about the rhythmic production of estrus and the coincident maturation of follicles.

PRYM, P. Histological changes following therapeutic roentgen irradiation. *Strablentherapie*, 1926, xxi, 319–327.

There is great difficulty in deciding whether certain structural characteristics are to be regarded as the results of irradiation or as spontaneous variations of the pathological process.

From the many studies made upon the tissue changes following therapeutic irradiation of various carcinomas, an approximate picture can be obtained as to the changes occurring as a result of the irradiation, although in the individual case one may see no changes whatever or only a slight indication of the well-known alterations. The essential change is a series of regressive and degenerative alterations of the specific tumor cells with processes of progressive proliferation and inflammatory changes in the interstitial tissue. The regressive processes are not distinguishable from the usual well-known degenerative changes occurring spontaneously in tumors; the differences at most are quantitative.

However, certain very striking pictures appear showing enlargement of the cells, and the nuclei becoming very chromophilic; and true cell monsters develop. A number of these forms may perhaps be due to the effect of roentgen rays upon cells undergoing division. By many, this enormous hypertrophy is regarded as a characteristic stage of the effect of roentgen rays. Whether all these elements finally undergo degeneration is undecided as yet. The actual disappearance of the cells is unfortu-

nately very difficult to follow in the histological picture. It is also difficult to decide from the histological picture whether there is a direct growth stimulating effect of roentgen rays upon the connective tissue, nor is it possible to decide that the breakdown of the specific tumor cells is due to a primary effect of the roentgen rays upon the vessels.

When we review all the findings described as following irradiation, we can say that they may very well be explained as due to a primary action upon the tumor cells themselves and secondary effects in the vascular system and interstitial tissues, and that we do not discover in these irradiated tissues any hitherto unknown degeneration or reaction forms. The body therefore reacts to irradiation exactly as it has been doing for ages to injuries imposed upon it.

RUSS, S., and SCOTT, G. M. The effect of *x*-rays upon Rous chicken tumour. *Lancet*, Aug. 21, 1926, ii, 374–375.

Ever since the initial work by Rous on the chicken sarcoma which bears his name, it has been recognized that this tumor differs from those propagated in rats and mice in that a cell-free filtrate obtained from the tumor when inoculated into chickens reproduces tumors indistinguishable from those produced by the inoculation of the actively growing cells. It has also been shown that the filtrate can be dried and kept for some time and will even then produce tumors.

Experiments show that very large doses of roentgen rays (five times that needed for a lethal action on other malignant growths) appear to have no appreciable effect on the Rous chicken sarcoma. Other experiments show that the virus of this tumor when treated separately is very resistant to roentgen rays. If a similar virus were present in malignant growths in the mouse, rat or man we should have to explain why a dose of roentgen rays will prevent the growth of these tumors while five times as much has no effect on the growth of the Rous sarcoma. It may be that the animal tumors do not contain a similar virus to the Rous or that its susceptibility to roentgen rays depends upon the tissue in which it exists, or that there is some substance at present unrecognized essential to the growth of these tumors which is easily affected by roentgen rays.

SCHREUS, HANS TH. Ray hardness, filtration and effects in dermatological irradiations. *Strablentherapie*, 1926, xxi, 328–333.

In surface therapy the technique of irradiation is much simpler than in deep therapy and the problem of dosage is not so difficult. An answer is sought to the question, is it possible with our present physical knowledge and clinical experience to decide whether any specific hardness of rays may be designated as the most favorable? By "most favorable effect" is to be understood that result of irradiation in which there is a minimum of unfavorable side effects associated with the best possible clinical result in dermatological cases. The question may be answered in the affirmative, within certain limitations. An experience of many years in the treatment of extensive dermatoses such as eczema and psoriasis has shown that the action of soft rays has been very effective and practically without danger. Physical science also confirms this view since the soft rays are absorbed practically completely in the superficial layers of the epidermis and the papillary layer. The tendency in recent years, however, has been toward the use of harder rays despite the above considerations. This is due to a belief that the softer rays are responsible for some of the late after-effects of irradiation, and the suggestion has been made that weak filtration with aluminum can prevent such injuries.

An experimental test was made of this point by the author, and it was found that when the roentgen tube is operated, as customarily, at 2 ma. with a fixed voltage, and then if the amperage is reduced while the voltage is increased without accurate control that the error in dosage may be as much as 10 per cent and the introduction of an aluminum filter 0.5 mm. thick does not affect the variations. There is consequently no protective effect of a filter. There therefore seems to be no good reason for giving up the treatment with unfiltered radiation in favor of mild filtration in the roentgen therapy of superficial dermatoses.

STROHL, ANDRÉ. Opening lecture of the course in medical physics at the Faculty of Medicine of Paris. *J. de radiol. et. d'électrol., Par.*, August, 1926, x, 337–344.

After reviewing the many fields of medicine in which a thorough knowledge of the principles of physics is necessary, Strohl emphasizes the fact that the very principles themselves on which the structure of modern physics is based and which had seemed unshakable are now under discussion. And medicine whose foundations are not nearly so solid is even now undergoing constant changes and without doubt will be called upon to undergo still greater ones in the future. It is becoming more and more necessary for the physician to be thoroughly conversant with physics and chemistry, on which physiology, pathology and even therapeutics are based and in the study of which a multitude of new facts and methods will be brought out. It is the duty of the professor of medical phy-

sics to act as a connecting link between the pure physicist and the biologist, and it is a field that is bound to increase in scope and value. For this reason the establishment of this chair of medical physics is an important step in medical education.

VANONI, ENZO PUGNO. An auto-protected diagnosis tube. *Radiol. med.*, August, 1926, xiii, 541–545.

The anticathode when struck by the rays from the cathode gives out roentgen rays in all directions, with a spherical surface. The rays used in treatment correspond to only a small segment of this sphere while the unused ones produce secondary soft rays which are very injurious. And inside the tube the rebound of electrons on the surface of the anticathode increases the harmful irradiation which is not utilized. For this reason protection to be effective would have to enclose the tube completely and as materials very opaque to roentgen rays are all conductors of electricity, to ensure electrical insulation of the tube the protector would have to be very large and heavy. Therefore efforts are being made to manufacture auto-protected tubes.

In the one described and tested by the author the anticathode is enclosed in a box of copper which absorbs all the rays but the ones that are to be utilized, which find an exit through a window of beryl. The tube can be used just like an ordinary tube for the protection is all inside it. The degree of protection afforded by the tube and the clearness of the images were determined by photographic methods and by comparison with normal tubes the decrease in the yield due to the beryl filter was measured. The degree of protection was found to be satisfactory. The pictures obtained with the protected tube were clearer, with the same charge, than those obtained with a normal tube. The reduction in the yield of rays due to the beryl decreases greatly as the opacity of the body to be examined increases and it is not so great as to offset the two advantages described above.

WERMEL, S. The roentgen activity of *in vitro* roentgenized substances. *Strahlentherapie*, 1926, xxi, 527.

The author calls attention to some of his own work published in 1913 and 1914 in regard to the general effect of roentgen rays upon normal horse serum. He found in over 400 cases of non-visceral tuberculosis that this roentgenized serum exerted a certain curative effect. Injection of the irradiated serum into rabbits produced a characteristic curve of leucocyte breakdown, and the site of injection showed a local, typical roentgen epilation. In addition the animals thus treated lost their power of reproduction.

WHITAKER, LESTER R. The mechanism of the gall bladder. *Am. J. Physiol.*, Oct. 1, 1926, lxxviii, 411–436.

It is a concept long held by physiologists that the contents of the gall-bladder find their way into the duodenum during digestion. But an empty gall-bladder is rarely seen either in laboratory animals or during operations on man, probably for the reason that experiments and operations are commonly made on temporarily fasting subjects. Recently it has been shown with the aid of the new Graham method that ingestion of foods rich in fat was nearly always followed by a decrease in the size of the gall-bladder shadow with eventual disappearance within three to six hours. Serial roentgenograms have shown that egg yolk has a practicularly striking effect on the human gall-bladder causing an even more prompt diminution and disappearance of the gall-bladder shadow than when butter was used. However, that the gall-bladder actually expels its contents into the duodenum in response to the ingestion of certain foods has never been demonstrated.

This process of bile expulsion was studied by the author in cats. Cholecystography by two methods was employed: (1) the Graham and Cole procedure with intravenous injection of the dye, and (2) an original method employing the direct injection into the gall-bladder of iodized oil. The second procedure has the advantage of greater opacity of the medium so that continuous roentgenoscopic observations can be made. The second procedure was as follows: Cats were fasted for at least twenty-four hours and were then subjected to laparotomy under aseptic conditions, the gall-bladder being opened, emptied of its bile, filled with iodized oil, sewed up, and the abdomen closed. Tests were made after the animal had fully recovered from the operation, usually within twenty-four hours, no food being given meanwhile.

By the employment of iodized oil as the opaque medium the gall-bladder is shown to empty its contents into the duodenum during the digestion of fats. This emptying is produced primarily by the muscular tunic of the gall-bladder, extrinsic mechanical factors having no appreciable effect. Emptying probably does not depend upon a reflex nervous mechanism involving extrinsic nerves since vagal stimulation has no effect and denervated gall-bladders empty normally.

There is no direct evidence that the expulsive action of the gall-bladder is due to a hormone

although it invariably depends upon the digestion and absorption of proteins or fats, especially the latter. The action of the so-called sphincter papillae seems to be to allow the gall-bladder to fill during the interval between periods of digestion; but the vesicle will not empty after the sphincter is cut, feeding being necessary, as in normal animals to effect this result.

ZIMMERN, A. Spectrography of roentgen rays. *J. de radiol. et d'électrol., Par.*, August, 1926, x, 345–358.

The discovery of the spectrography of roentgen rays has brought about enormous advances in the knowledge of the atomic structure not only of crystals and metals but also of organic substances. In medical roentgenology it shows the exact nature and composition of the anticathode, shows the region absorbed by a filter by means of the anticathode, shows the region absorbed by a filter by means of taking a comparative spectrogram with and without filter and also, which is its most important use, determines the exact quality of the radiation, which is defined by the minimum wave length present in the bundle of rays. Aside from spectrography there is no direct method of determining exactly the quality of the rays. There are instruments of the nature of Benoist's radiochromometer but they give only the average value of the degree of penetration, but two bundles of rays may have the same average hardness and differ completely in the rays composing them. Hardness can also be measured indirectly by the spark gap but measurement by spectrography, in addition to being much more accurate, is independent of the electric current.

The spectroscope-spectrograph of March is especially adapted to the needs of medical roentgenology. Its special object is observation of the shortest wave length. This is shown on a fluorescent screen graduated in wave lengths and immediately furnishes a measure of the hardness of the radiation being used. Details of the construction of this and other spectrographs are described.

ANSCHUTZ, W., and HELLMANN, JOHANNA. The results of after-irradiation of radically operated mammary carcinomas. *Deutsche Ztschr. f. Chir.*, 1926, cxcvii, 47–65.

It is agreed on all sides that postoperative irradiation according to the method of Wintz with the full or almost full carcinoma dose is in the majority of cases not the correct one and does not improve the operative results. On the other hand, there is still a question whether the procedure of the Kiel Clinic in administering small summative doses of roentgen rays is actually of value. It is the author's view that the proper basis for judging results statistically is the duration of life and not on the time of recurrence or appearance of metastases, because it is not always easy to recognize the precise time of appearance of the recurrence.

Since 1921 there have been under observation in the Kiel Clinic 116 cases without postoperative irradiation and 215 cases irradiated after radical operation. These were all cases that had been followed three to five years after operation. All the tumors were examined microscopically. The end-results are in favor of the procedure of administering small summative doses. The statistics show slightly more favorable results in the cases treated before 1921, and the authors believe that the difference is due to a change in the method of irradiation. There were some cases of roentgen burns which caused a retreat to smaller doses. It now appears that although roentgen injuries have been eliminated in more recent statistics the end-results are not so favorable. It is interesting to note that the cases developing roentgen injuries never showed recurrence of the cancer.

As a result, the following new method of irradiation is proposed: Irradiation should be given over three fields (side of the breast, axilla, clavicular region) with about 6 to – exposures at successive intervals of four weeks; then a pause of two to three months increasing to pauses of four to six months with treatments continuing to the end of the second year; so that at the end of the second year there will be a total of ten to eleven treatments. The patient should be under continued observation, and in the event of a recurrence should be at once irradiated. Should the condition of the skin or the general condition of the patient not permit the frequently repeated irradiations, longer pauses between treatments should be maintained and the total time extended perhaps to three years. Whether it is advisable to go back from two-thirds of the skin erythema dose to one-half remains to be seen. The authors propose to continue with the two-thirds skin erythema dose at each treatment. It is emphasized however that a rigid scheme of treatment should not be attempted.

BARDACHZI, FRANZ. Practical treatment of myomas and hemorrhagic metropathies with roentgen rays. *Strahlentherapie*, 1926, xxi, 397–405.

Experience shows that it is most practical as a rule to administer the roentgen treatment at a single sitting, if possible. This is especially indicated in urgent cases such as in acute hemorrhages with high grade anemia. There is often a further indication in these urgent cases to

support the ovarian treatment with irradiations of the spleen or liver. The author's experience is that this procedure is accompanied by excellent results. It is, however, justifiable in the case of older women suffering from mild hemorrhages and symptoms to try to get along with a smaller dose of roentgen rays. In these cases the best procedure is to follow the first treatment with another irradiation should three menstruations appear after the first treatment.

For the single exposure method the least dangerous procedure, especially in the case of large tumors and robust patients, is the distant field irradiation. This yields the best depth effect, the surest hitting of the ovaries which are often so difficult to locate, and it has the further advantage of giving a myoma a most uniform irradiation. Medium compression is often advantageous in increasing the depth dose and decreasing the time of irradiation. The castration dose is given in a maximum of two and a half hours to strong women by employing a focal skin distance of 50 cm., with a Stabilivolt apparatus operated at 3.5 ma., 200 kv., the rays being filtered through 0.5 mm. Cu. The author's calculation of his skin erythema dose is 180 F units; and by administering 140 F through a frontal field 20 cm. in diameter and 60 F through the back, he avoids all danger of producing injury.

In weaker patients the required doses are naturally much smaller, and for these patients the duration of treatment can be still further shortened by decreasing the focal skin distance. Thus in emaciated patients, a completely satisfactory radiation treatment may be administered through a single field at a focal skin distance of 40 or even 30 cm. In many cases, it seems advisable to decrease the time of exposure still further by exposing both ovaries simultaneously with the aid of a compression tube.

BUMPUS, HERMON C., JR. Carcinoma of the prostate. *Surg., Gynec. & Obst.*, August, 1926, xliii, 150–155.

A summary is given of the clinical study of 1000 cases of carcinoma of the prostate seen at the Mayo Clinic prior to January, 1925, complete records being available for 90 per cent of the cases in this series.

The average age was sixty-five years, and in no case was it encountered before the forty-second year. Neoplasm of the prostate occurring prior to the age of forty should be sarcoma. Frequency and difficulty of urination were given as the usual symptoms, after which there developed pain. Metastasis to the lymphatic system was demonstrable in 243 of the cases. While the lymphatic system without doubt is the earliest and most frequent site of metastatic lesions, they are far easier to detect in the osseous tissue for they are usually of the osteoblastic type and the increase in density of the bone renders them discernible roentgenographically. The most common site of involvement is the sacrum and adjacent portions of the spine and pelvis. Early metastatic lesions are difficult to distinguish from areas of osteitis, and when the latter are found in the sacroiliac region in men of prostatic age, the diagnosis should not be confirmed until careful rectal examination has ruled out the possibility of malignant disease of the prostate.

A more frequent cause of confusion in the more advanced cases is the differentiation from Paget's disease. In the latter, the bodies of the lumbar vertebrae are flattened and widened, and there is increased density without destruction, while with metastases there is little, if any, change in the shape of the vertebrae, but the increase in density is associated with destruction of tissue. In this connection roentgenograms of the head should be studied. Metastases to the lungs were found in a few cases, but for diagnosing the presence or absence of metastases roentgenographically a plate including the spine, pelvis and upper femurs would seem all that is necessary.

Eleven of the patients had metastases to the spinal cord and a number of others showed metastases to the skin, liver and kidneys.

Completed records of 164 cases in which prostatectomy was performed show 21 five year cures. This figure should make one hesitate to recommend surgical treatment when the disease has advanced sufficiently to be positively diagnosed.

Because of the poor surgical results, treatment by radium was tried. At first the method of administration (in the rectum directly over the prostate) was very crude and inefficient, and of 35 patients so treated all but one are dead, and many suffered severely from proctitis. An additional group of 35 was treated by the insertion of radium bearing needles plunged through the perineum. Only 3 of these patients are alive. The average length of life for the group was sixteen months after application of radium, very little longer than for patients receiving no treatment.

In subsequent cases, the radium was applied through the urethra by means of emanation seeds inserted directly into the gland as well as through the perineum and over the rectal surface. Of 122 patients so treated there are completed records of 112. The average dose was a little over 2000 mg-hr., and the patients lived an average of twenty-two months following treatment. Of these 25 are still alive, 9 more

than three years, 4 of whom have lived more than five years. These results are about equal to those obtained by the surgical treatment, considering that these cases were not as carefully selected.

In a few cases prostatectomy followed radium irradiation of the gland, and the results were so poor that the method was quickly abandoned. In other cases radium was administered after prostatectomy when the pathological examination showed little involvement. Here seems to be the greatest field of usefulness for radium in connection with malignant disease of the prostate. Surgical procedure should be such as to expose the neoplasm and make it essentially a surface lesion, thus permitting a more accessible approach for the radium.

Suprapubic cystostomy has been found to be more free from risk, to cause less suffering and to lengthen life more than any other form of treatment thus far tried.

DÖDERLEIN, GUSTAV. Origin, symptoms and treatment of female genital tuberculosis. *Beitr. z. klin. Tuberk.*, 1926, lxiii, 672–683.

Genital tuberculosis is about ten times more frequent in females than in males and this undoubtedly is due to the anatomical and functional peculiarities of the female genital tract. The infection in the female is almost exclusively a secondary descending tuberculosis. It is of course conceivable that a primary ascending infection may take place, but there have been no post mortem anatomical findings as yet to show that this has occurred. Although the anatomical picture of female genital tuberculosis is well characterized, the clinical symptoms are not very typical and occasionally it may be very difficult, if not impossible, to diagnose the specific process from results of palpation and examination of various secretions; so that frequently the presence of a primary tuberculosis in some other region may be the first indication of the nature of the process. The main symptoms are pain, menorrhea, and irregularities in the menstrual cycle.

From the fact that female genital tuberculosis is primarily a secondary disease, the local therapeutic measures must naturally be adjusted to the stage of the primary complaint. The symptoms of genital tuberculosis are hardly ever so urgent as to demand an immediate interference. Surgical intervention where indicated should not be too radical nor too conservative, because in each event the results are not improved. The number of operations from now on will become less and less owing to the uniformly good results reported on all sides from the employment of roentgen rays. It is pointed out that roentgen treatment will not entirely eliminate the necessity for operations since in many cases the diagnosis is not definitely established until after an exploratory laparotomy. However, an intelligent after-irradiation improves the end results so considerably as to encourage the surgeon to remain content with a simple laparotomy or at least with the slightest operation possible.

The older idea of applying heavy doses of roentgen rays in the treatment of genital tuberculosis has been shown to be erroneous, and the author has gradually reduced his dosage. At present, the rays are produced by a Stabilivolt apparatus with a Coolidge tube at a potential of 200 kv., 2.5 ma., filtered through 1 mm. Cu. An abdominal field of about 10 × 15 cm. is exposed at a focal skin distance of 40–60 cm., depending on the fat layer in the patient. The aim is to deliver $\frac{1}{10}$ of a skin erythema dose at the peritoneum. These small quantities of radiation appear to be sufficient to destroy the epithelioid and giant cells and to greatly reduce the number of lymphocytes and plasma cells. How the rays actually aid in the curative process is not known, but there is a certain amount of plausibility in the theory of Iselin that ferments liberated from the cells destroyed by the rays initiate an active immunization. A rigid scheme for roentgenization is impossible. The treatment should be adjusted to the age, symptoms and general condition of the patient. The results of the combined medical, operative and roentgen treatment are considered to be very satisfactory. It is pointed out, however, that actual cure in the anatomical and biological sense cannot be established clinically in genital tuberculosis. All that can be done is to note the subjective improvement, the increase in bodily strength, etc.

FINTON, W. L., and SHAEFFER, A. M. A goitre resume. *J. Mich. M. Soc.*, July, 1926, xxv, 338–341.

Surgery is recommended by the authors on an average to only about one goiter patient out of three (in adults). Only rarely should surgery be recommended in cases under twenty years of age. Roentgen treatments to do any good should be given in fairly good doses and repeated every two weeks, the total being usually from three to six treatments. Radium may be substituted if patients cannot be moved to the roentgen machine. The mode of application of roentgen rays has certain mechanical advantages over that of radium. The consensus of opinion seems to be that roentgen rays cause temporary benefit in most cases of mildly toxic goiter.

It is the authors' observation that the patient with a "goiter heart" is a better surgi-

cal risk than is popularly supposed. Patients with hyperthyroidism and bad hearts should not be refused surgical relief.

FRAZIER, CHARLES H., and MOSSER, W. BLAIR. A system of control and treatment in the toxic goitre. *Ann. Surg.*, July, 1926, lxxxiv, 51–56.

A thyroid clinic has been evolved at the University Hospital, Philadelphia, officered by representatives of the medical, surgical and roentgen-ray services; in this clinic all patients with diseases of the thyroid gland are registered no matter on what service they may be entered originally, and on their discharge from the hospital the entire group is subjected to the same continuation of observations.

At the present time, surgical treatment offers to the patient suffering either from exophthalmic goiter or toxic adenoma by far the best hope for recovery. A conservative estimate of operative results from various clinics shows that recovery is to be expected in about 60 per cent of cases; improvement in 30 per cent, and no improvement in 10 per cent. The results of medical treatment could probably be indicated by reversing the order of these figures. Roentgen treatment, while of some benefit to a large proportion of purely exophthalmic cases is, according to those best informed on this subject, curative in only a very small number.

Surgical management of the toxic goiter patient is largely a matter of observing certain fundamental principles and applying them routinely to all cases, as it is impossible to predict the postoperative reaction by the degree of apparent toxicity. Every toxic patient is placed on the anoci-association technique, put at absolute physiological rest, given mild sedatives as indicated, and iodine as a specific in certain instances. The anoci-association technique, whereby the patient is kept in ignorance of the fact that he is to be operated on or of the time of operation, if he has been previously told that operation is necessary, is a valuable adjunct since mental and psychic disturbances are avoided. Such a procedure is necessary in only about 5 per cent of cases.

Administration of iodine as a pre-operative procedure in exophthalmic cases is always practiced, since its effect is so remarkable as to be considered practically specific. In the treatment of toxic adenomas the routine use of iodine is not subscribed to by the author. It undoudtedly benefits a large proportion of these cases, but some unfavorable reactions have been seen which make dubious the routine use of this drug. Under no circumstances should iodine be given to a patient with an adenoma, except when the patient is in the hospital where he is being prepared for operation. Iodine, while one of our most valuable adjuncts in the surgical management of hyperthyroidism, has probably done more harm to patients with goiter than any other drug.

Since the operative procedure is one of election uninfluenced by immediate necessity, it follows that it should be performed when the point of maximum improvement after iodine therapy has been attained. The operation of choice is a bilateral subtotal thyroidectomy, and it is only by ultimately reaching this stage that cure can be expected. Various factors often demand a series of operations before complete removal is possible. It is largely through experience that judgment as to the correct procedure for the individual case is attained. Each patient should be evaluated soon after admission and the treatment planned accordingly.

The mortality statistics have been materially reduced since the advent of iodine therapy. Previous to 1920 the mortality in toxic cases averaged 2.77 per cent; since then there have been 262 consecutive operations on patients with toxic goiter with only 2 deaths, a mortality of less than 0.8 per cent (one of these deaths was unavoidable).

HARROLD, CHARLES C. Shall cancer be treated by radium or by surgery? *J. Med. Ass. Georgia*, October, 1926, xv, 394–395.

It seems out of the question to hope that one method of treatment will serve for all malignant growths. In cancer of the breast, surgery should be resorted to early and radically. The author sees not much result from the use of roentgen rays except in extensive skin involvements where it probably prolongs life somewhat. He does not believe that radium has any place at all in the treatment of cancer of the breast, not even in the recurrent skin nodules unless as an adjunct to the radical surgical removal.

In superficial keratosis and in skin cancers, radium seems to be the accepted treatment and seems to be definitely valuable. If the skin cancer extends to the cartilage as in the ear, surgery or electrocautery is preferable.

In the treatment of cancer of the lip there is great diversity of opinion. Radium should be used if superficial keratosis is present. If the lesion is more advanced it should be removed surgically. In late, bad cases radium may be used to prolong life. In cancer of the tongue it seems that at least 2 cases out of 3 are doomed. Radium is used in some clinics for tongue cancer, and in others electrocautery is used followed by dissection.

Treatment seems more definitely promising in cancer of the uterus. Almost everyone agrees

that the treatment of choice in cancer of the cervix is radium and in cancer of the fundus, complete hysterectomy. "I still, however, see cancers of the cervix operated on in Georgia by surgeons who can make no money by referring their cases to men with radium." It seems inexcusable for a surgeon to do a hysterectomy for a cancer of the cervix, and then refer the case for radium treatment when the inevitable recurrence appears. In treating cancer of the cervix the author administers 1750 units the first twenty-four hours and 650 the second, with a diminishing dose each subsequent day. The first is the only day when radium element is used, each succeeding day the dosage being from radium emanation seeds.

In cancers of the parotid, treatment with radium emanation seeds, though not perfect, seems to be the best at present. The author has under observation and treatment 6 such cases; and thus far all are doing well with no paralysis and only one slight fistula which has recently closed.

JACOBS, A. W. Carcinoma of the rectum and sigmoid. *Surg., Gynec. & Obst.*, July, 1926, xliii, 50–53.

An analysis is given of 125 cases of carcinoma of the rectum admitted to the Montefiore Hospital, New York City. Of the entire series 26 cases were treated by radium or deep roentgen therapy, either alone or in combination, with temporary improvement or palliation of symptoms in 9 cases. Brief abstracts of 4 such cases are given. The first case has remained free from symptoms two years and eight months; the second case died four years after onset; the third died in three and a half years; the fourth case has been under observation one year and the condition appears to be under control.

It is concluded that the majority of cases of carcinoma of the rectum are recognized when it is too late to accomplish much by radical surgery, and surgical statistics in the advanced cases are not encouraging. Here a proper combination of surgery and radiotherapy may accomplish something toward alleviation.

Radium when properly applied will inhibit and destroy a majority of rectal neoplasms. Radium is a valuable adjunct to surgical procedures and in selected cases pre- and post-operative irradiation should be practiced.

Deep roentgen therapy should also be given in the pelvis with the hope, first, of destroying or decreasing the amount of lymphatic tissue and thus decreasing the opportunity for metastasis; and second of destroying or inhibiting the growth of metastatic nodules.

KING, JAMES M. Cancer of the skin and mouth. *J. Tenn. M. Ass.*, September, 1926, xix, 115–120.

The author lays emphasis upon the value of the electrocautery in the removal of malignant tumors when the wound is to be left open and treated with roentgen rays. Under local anesthesia, it enables one to do practically a bloodless operation, and the tissue to be severed is in a clean bloodless field.

General descriptions are given of rodent cancer and prickle or squamous cell epithelioma, their clinical features, diagnosis and treatment.

The large flat epitheliomas the size of a quarter or a silver dollar, ulcerated or not, should be treated with roentgen rays or radium, roentgen rays preferably on account of the area. Large deep-seated nodular or larger ulcerated tumors should first be removed with electrocautery, and then the open wound treated with roentgen rays at intervals, allowing the wound to heal by granulation. The adjacent glands are not to be considered unless it is found that a squamous cell epithelioma has engrafted itself upon a basal cell type. The one necessary requirement for success in handling cancer is experience. Recurrence will appear, if treatment is not thorough.